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RESEARCH PAPER P-124

EFFECTIVE COLLISION FREQUENCIES AND ELECTRIC CONDUCTIVITIES OF WEAKLY IONIZED N_2, O_2, N, O, NO, and DRY AIR

Adolf R. Hochstim

February 1965

INSTITUTE FOR DEFENSE ANALYSES
RESEARCH AND ENGINEERING SUPPORT DIVISION

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Contract SD-50
ARPA Assignment 5

ABSTRACT

In calculating the electric conductivity of gases and plasmas, it is not sufficient to define only one effective collision frequency. Two independent quantities are defined and tabulated as a function of the ratios of microwave frequency to an average collision frequency for very weakly ionized O_2, N_2, and dry air, for 100° K $\leq T \leq 2000^\circ$ K, using the best experimental electron-neutral cross sections.

The average electron-neutral collision frequency (defined for microwave frequencies which are much greater than collision frequency) was tabulated for N_2, O_2, N, O, NO, and air for $T \leq 10{,}000^\circ$ K. At lower temperatures it was found that for air

$$\bar{\nu}(\sec^{-1}) \simeq 2 \times 10^8 \, P_{mm\,Hg}, \text{ for } 200^\circ < T < 600^\circ \text{ K.}$$

Also included are tables for an idealized single-component weakly ionized gas whose collision frequency has a power law dependence on the velocity (with the exponent in the range of -3 to + 3).

The data could be applied to the interpretation of the attenuation of electromagnetic waves through the ionosphere, through rocket exhausts, in plasma diagnostics, radar blackout, reentry phenomena, etc.

This report is being issued to facilitate the use of many numerical results for use in Project DEFENDER. These results will be incorporated with an extensive text in <u>Transport Processes and Microwave Propagation in Plasma</u>.[1]

ACKNOWLEDGMENT

The author wishes to acknowledge the very conscientious and active programming and computing assistance of Mrs. Marion Fickett.

NOTATION

c = velocity of light in a vacuum, $c = 3 \times 10^{10}$ cm/sec

d = thickness of plasma slab

db = decibels, $T(db) = -10 \log_{10} T$

E or E_{ev} = electron energy in electron volts, 1 ev = 11,606° K

k = Boltzmann constant

L_o = Loschmidt number, $L_o = 2.6871 \times 10^{19}$ cm^{-3}

m = mass of electron

N_e = number of electrons in 1 cm^3, $\omega_p = 5.641 \times 10^4 \sqrt{N_e}$

N_i = concentration of i-th specie per cm^3

Q_i = electron neutral cross section for momentum transfer (in cm^2)

T = absolute temperature in ° K (if not specified, $T \equiv T_e$)

$T(db)$ = fraction of transmitted energy through homogeneous plasma slab in dicibels

v = electron velocity, T_e - electron temperature

$\alpha_1 = (\omega/\nu)_{eff}/(\omega/\bar{\nu})$

$\alpha_2 = (\omega_p/\nu)_{eff}/(\omega_p/\bar{\nu})$

$\alpha_3 = \alpha_2/\alpha_1 = (\omega_p/\omega)_{eff}/(\omega_p/\omega)$

ϵ' = complex dielectric constant, $\epsilon' = \epsilon_r + i\epsilon_i$ (Eq. 1)

λ_o = wavelength of microwaves in a vacuum

ν = total collision frequency of electrons with neutrals and ions

$\bar{\nu}$ = average collision frequency at $\omega \gg \nu$, defined in Eq. 20

ρ = mass density, gm/cm^3

σ = complex electric conductivity (Eq. 5)

ω = microwave angular frequency, $\omega = 2\pi f = 2\pi c/\lambda_o$

ω_p = (angular) plasma frequency, $\omega_p = 2\pi f_p$, $\omega_p = \sqrt{\dfrac{4\pi N_e e^2}{m_e}}$

CONTENTS

I. THE EFFECTIVE QUANTITIES

Let the complex dielectric constant of plasma in the absence of external magnetic fields be written as[1,2]

$$\epsilon' = \epsilon_r + i\epsilon_i \tag{1}$$

$$\epsilon_r = 1 - \left(\frac{\omega_p}{\omega}\right)^2 I_2 = 1 - \frac{(\omega_p/\nu)^2_{eff}}{1+(\omega/\nu)^2_{eff}} \tag{2}$$

$$\epsilon_i = \left(\frac{\omega_p}{\omega}\right)^2 I_1 = \frac{(\omega_p/\nu)^2_{eff}}{\left(\frac{\omega}{\nu}\right)_{eff} \left\{1+\left(\frac{\omega}{\nu}\right)^2_{eff}\right\}} \quad . \tag{3}$$

The complex conductivity, σ', is related to ϵ' by

$$\epsilon' = 1 + \frac{\sigma'}{\omega} i \tag{4}$$

$$\sigma' = \sigma_r + i\sigma_i = (I_1 + iI_2)\,\frac{\omega_p^2}{\omega} \quad . \tag{5}$$

Thus, one can uniquely define the following effective quantities

$$\left(\frac{\omega}{\nu}\right)_{eff} = \frac{\sigma_i}{\sigma_r} = \frac{I_2}{I_1}; \quad \alpha_1 = \frac{(\omega/\nu)_{eff}}{\omega/\bar{\nu}} \tag{6}$$

$$\left(\frac{\omega_p}{\nu}\right)_{eff} = \frac{\omega_p}{\omega}\, g; \qquad \alpha_2 = \frac{(\omega_p/\nu)_{eff}}{\omega_p/\bar{\nu}} \tag{7}$$

$$\left(\frac{\omega_p}{\omega}\right)_{eff} = \frac{\omega_p}{\omega}\, g\, \frac{I_1}{I_2}; \quad \alpha_3 = \alpha_2/\alpha_1 = \frac{(\omega_p/\omega)_{eff}}{\omega_p/\omega} \;, \tag{8}$$

where

$$g = \sqrt{I_2 \ (1 + I_2^2 / I_1^2)}, \tag{9}$$

Furthermore,

$$\sigma' = \frac{\alpha_2 \alpha_3 \omega_p^2}{\bar{\nu} - i\alpha_1 \omega} \tag{10}$$

A. VARIOUS CALCULATIONS OF I_1 AND I_2

1. Solution for Weakly Ionized Plasma

For a given plasma, one can in principle obtain the total collision frequency as the sum of electron ion and electron neutral collision frequency; then $\nu = \nu(v)$. For a given electron distribution function f_o° we have[3,4,5] (weak electric fields[1])

$$I_1 = \frac{4\pi\omega}{3N_e} \int_0^\infty \frac{v^3 \nu}{\nu^2 + \omega^2} \frac{\partial f_o^\circ}{\partial v} dv \tag{11}$$

$$I_2 = \frac{4\pi\omega^2}{3N_e} \int_0^\infty \frac{v^3}{\nu^2 + \omega^2} \frac{\partial f_o^\circ}{\partial v} dv \quad . \tag{12}$$

For Maxwellian distribution

$$I_1 = \frac{8}{3\sqrt{\pi}} \omega \int_0^\infty \frac{\nu}{\nu^2 + \omega^2} e^{-u^2} u^4 du, \ u = v \sqrt{\frac{m_e}{2kT}} \tag{13}$$

$$I_2 = \frac{8}{3\sqrt{\pi}} \omega^2 \int_0^\infty \frac{1}{\nu^2 + \omega^2} e^{-u^2} u^4 du \tag{14}$$

2. Lorentz-Langevin Theory

For ν = constant = $\nu(T,\rho)$ the previous theory gives the classical[4,6] result for Maxwellian distribution

$$I_1 = \frac{\omega\,\bar{\nu}}{\bar{\nu}^2 + \omega^2}; \tag{15}$$

$$I_2 = \frac{\omega^2}{\bar{\nu}^2 + \omega^2}; \tag{16}$$

$$\left(\frac{\omega}{\nu}\right)_{eff} = \frac{\omega}{\bar{\nu}};\ \alpha_1 = 1 \tag{17}$$

$$\left(\frac{\omega_p}{\nu}\right)_{eff} = \frac{\omega_p}{\bar{\nu}};\ \alpha_2 = 1 \tag{18}$$

$$\left(\frac{\omega_p}{\omega}\right)_{eff} = \frac{\omega_p}{\omega};\ \alpha_3 = 1 \tag{19}$$

For $\omega \gg \nu$, if we define

$$\bar{\nu} = \frac{8}{3\sqrt{\pi}} \int_0^\infty \nu(u^2)\, u^4 e^{-u^2}\, du \tag{20}$$

$$= \frac{4}{3\sqrt{\pi}} \int_0^\infty \nu(W)\, W\sqrt{W}\, e^{-W}\, dW,$$

then

$$\alpha_1 = \alpha_2 = \alpha_3 = 1.$$

3. The value of the here introduced, and later tabulated (Table XIV, etc.) corrections (α_1, α_2, and α_3) is that these allow us using any previously solved cases of propagation of electromagnetic waves through a given plasma by interpreting the used ω_p/ν,

ω_p/ω and ω/ν as actually effective quantities. Thus, if somebody previously solved numerically homogeneous plasma slab using Lorentz' conductivity for $\omega_p/\omega = 1.0$ and $\omega/\nu = 0.09$ (with constant ν), we can still use the results for velocity dependent ν by interpreting the parameters as $(\omega_p/\omega)_{eff} = 1.0$ and $(\omega/\nu)_{eff} = 0.09$. Then, for example, for a particular plasma (e.g., $\nu \sim v^2$, Table XVII, p. 136) for a given $\omega_p/\omega = 1/0.6741$ one obtains $\alpha_3 = 0.6741$ and $\omega/\bar{\nu} = 0.025$. Thus, the reflection, transmission, etc. of the plasma having $\nu \sim v^2$ and $\omega_p/\omega = 1/0.6741$ and $\omega/\bar{\nu} = 0.025$ are exactly the same as for a plasma having ν = constant, $\omega_p/\omega = 1.0$ and $\omega/\nu = 0.09$.

B. APPROXIMATE SOLUTIONS FOR THE ELECTRICAL CONDUCTIVITY OF A PLASMA OF ANY DEGREE OF IONIZATION

Applying a series expansion of Laguerre polynominals in the solution of a plasma kinetic equation in which Coulomb collisions were described by the Fokker-Planck collision term and electron neutral collisions by the Boltzmann collision term, Shkarofsky[7] obtained the electric conductivity in terms of infinite matrix Δ (defined in his paper). Our functions I_1 and I_2 are related to his Δ as follows:

$$I_1 = \frac{\omega}{\bar{\nu}} \operatorname{Re} \left(\frac{|\Delta_{\infty}|}{|\Delta|} \right) \tag{21}$$

and

$$I_2 = \frac{\omega}{\bar{\nu}} \operatorname{Im} \left(- \frac{|\Delta_{\infty}|}{|\Delta|} \right) \tag{22}$$

where $\bar{\nu}$ is any average collision frequency and Δ_{∞} is the first minor of the Δ determinant. For Coulomb collisions (including the electron-electron term), their result is identical with Landshoff's[8]; however, their calculations were performed on a 4×4 matrix, which is one order higher than that used by Landshoff in his treatment of a fully ionized gas.

With $x = \frac{\omega}{\bar{\nu}}$

$$I_1 = \frac{g_\sigma \, x}{g_\sigma + x^2 \, h_\sigma^2}; \quad I_2 = \frac{h_\sigma \, x^2}{g_\sigma + x^2 \, h_\sigma^2} \tag{23}$$

where g_σ and h_σ are listed in Ref. 7 for certain plasmas, and where

$$\sigma' = (I_1 + iI_2) \frac{\omega_p^2}{\omega} = \frac{x}{g_\sigma^2 - ixh_\sigma} \frac{\omega_p^2}{\omega} \tag{24}$$

$$= \frac{\omega}{\bar{\nu}} \frac{\Delta_{\infty}}{\Delta}$$

Furthermore,

$$\left(\frac{\omega}{\nu}\right)_{eff} = \frac{\omega}{\bar{\nu}} \frac{h_\sigma}{g_\sigma} \tag{25}$$

$$\left(\frac{\omega_p}{\nu}\right)_{eff} = \frac{\omega_p}{\bar{\nu}} \frac{\sqrt{h_\sigma}}{g_\sigma} \tag{26}$$

$$\left(\frac{\omega_p}{\omega}\right)_{eff} = \frac{\omega_p}{\omega} \frac{1}{\sqrt{h_\sigma}} \tag{27}$$

All theories reduce in case $\omega \gg \nu$ to Eqs. 17, 18, and 19. The use of the Fokker-Planck equation in this method restricts ω to be less than ω_p for fully ionized plasmas.

We have generalized this method to include any degree of ionization for arbitrary dependence of cross sections on electron energy to any size of the determinants. Results will be given in a table of effective quantities in a subsequent report.[1,2] In this paper we list only

$$\alpha_1 = \frac{(\omega/\nu)_{eff}}{\omega/\bar{\nu}} \tag{28}$$

$$\alpha_2 = \frac{(\omega_p/\nu)_{eff}}{\omega_p/\bar{\nu}} \tag{29}$$

$$\alpha_3 = \frac{\alpha_1}{\alpha_2} = \frac{(\omega_p/\omega)_{eff}}{\omega_p/\omega} \tag{30}$$

and

$$\bar{\nu} = \frac{4}{3\sqrt{\pi}} \int_0^\infty \nu(W)\, W \sqrt{W}\, e^{-W}\, dW, \quad W = \frac{1}{2}\frac{mv^2}{kT}, \tag{31}$$

(which corresponds to weakly ionized gas theory for the case of $\omega \gg \bar{\nu}$).

For practical evaluation of the integrals it is convenient to examine the dependence of cross sections on energy E given in electron volts (see Table III). Let

$$Q_i\ (W) = \sum_{\ell} g^i_{\ell}\ E^{\ell}_{ev} = \sum_{\ell} g^i_{\ell} \left(\frac{T \cdot 10^{-4}}{1.1606}\right)^{\ell} W^{\ell} \tag{32}$$

$$\bar{\nu} = \frac{4}{3\sqrt{\pi}} \sqrt{\frac{2kT}{m}} \sum_i N_i \int_0^{\infty} Q_i\ (W) W^2\ e^{-W}\ dW \tag{33}$$

then

$$\bar{\nu} = \frac{4}{3\sqrt{\pi}} \sqrt{\frac{2kT}{m}} \frac{\rho}{\rho_0} L_0 \sum_i a_i \sum_{\ell} (\ell+2)! \left(\frac{T \cdot 10^{-4}}{1.1606}\right)^{\ell} g^i_{\ell},$$

$$= 1.11288\times10^{35} \frac{\rho}{\rho_0} \sqrt{T} \sum_i a_i \sum_{\ell} (\ell+2)! \left(\frac{T \cdot 10^{-4}}{1.1606}\right)^{\ell} g^i_{\ell} \tag{34}$$

where

$$W = \frac{1.1606\times10^4\ E_{ev}}{T(^{\circ}K)} \tag{35}$$

and N_i is the number of i-th particles in 1 cm^3, given by the relation

$$N_i = a_i \frac{\rho}{\rho_0} L_0 , \tag{36}$$

where L_0 is the Loschmidt number and ρ is the mass density. Often in the literature of this topic appears the average collision frequency taken at the energy of kT, i.e.,

$$\frac{1}{2} m_e v_m^2 = E_m = kT,\ Q_m = Q(E_m);\ \nu_m = NQ_m v_m$$

For a simple energy dependence of the cross section in one component gas

$$Q_m = g\, E_m^n\ (ev) = g \left(\frac{T \cdot 10^{-4}}{1.1606}\right)^n \tag{37}$$

and

$$\nu_m = N \sqrt{\frac{2kT}{m_e}}\, g \left(\frac{T \cdot 10^{-4}}{1.1606}\right)^n \tag{38}$$

Now,

$$\bar{\nu} = \frac{4}{3\sqrt{\pi}}\,(n+2)!\ \nu_m \tag{39}$$

Thus, for

$$Q \sim E_{ev}^{-\frac{1}{2}},\ \bar{\nu} = \nu_m \tag{40}$$

$$Q \sim \sqrt{E_{ev}},\ \bar{\nu} = \frac{5}{2}\,\nu_m \tag{41}$$

$$Q \sim E_{ev},\ \bar{\nu} = \frac{8}{\sqrt{\pi}}\,\nu_m, \tag{42}$$

etc. In Table XVII we list effective corrections α_1, α_2, and α_3 for $n = -3, -2.5, -2.0, \ldots 2.5, 3.0$, where

$$\nu = Av^n$$

II. USE OF EFFECTIVE α'S IN MICROWAVE PROPAGATION THROUGH HOMOGENEOUS PLASMA SLAB

For a homogeneous plasma slab under the condition* that $\omega_p^2 < \omega^2 + \nu^2$ and

$$\frac{\omega_p^2}{\omega^2 + \nu^2}\;\frac{\nu}{\omega} < 1$$

(i.e., for $\epsilon_r \sim 1$, $\epsilon_i \ll 1$), the fraction of the transmitted microwave energy is given (in decibels) by[1]

$$T(db) = -10\log_{10} e^{-\beta} \simeq 1.447\times 10^{-10}\,\frac{\omega_p^2\,\nu}{\omega^2 + \nu^2}\,d_{cm} \qquad (43)$$

Expressing the formula through correct effective quantities we obtain

$$\frac{T(db)}{d_{km}} = 1.477\times 10^{-5}\,\frac{\left(\frac{\omega_p}{\nu}\right)^2_{eff}\,\omega}{\left[\left(\frac{\omega}{\nu}\right)^2_{eff} + 1\right]\left(\frac{\omega}{\nu}\right)_{eff}}$$

$$= 1.447\times 10^{-5}\,\frac{\alpha_2^2\left(\frac{\omega_p}{\bar{\nu}}\right)^2\omega}{\left[\alpha_1^2\left(\frac{\omega}{\bar{\nu}}\right)^2 + 1\right]\frac{\omega}{\bar{\nu}}\,\alpha_1} \qquad (44)$$

---

*The conditions for low temperature air are

$N_e <$ [redacted] 0.12 $\times 10^8\, P^2_{mm\,Hg}\left[1+\alpha_1^2(\omega/\bar{\nu})^2\right]\alpha_2^{-2} = N_e^o$ and also

$$N_e < N_e^o\,\alpha_1\,\omega/\bar{\nu}$$

and finally

$$\frac{T(db)}{d_{km}} = 1.447 \times 10^{-5} \frac{\alpha_2^2}{\alpha_1} \frac{\omega_p^2 \bar{\nu}}{(\alpha_1^2 \omega^2 + \bar{\nu}^2)}, \quad \frac{\alpha_2^2}{\alpha_1} = \alpha_3 \alpha_2 \tag{45}$$

For $\omega \gg \bar{\nu}$ for air at $T = 250°$ K (Model I)

$$\frac{T(db)}{d_{km}} = 1.447 \times 10^{-5} \left(\frac{\omega_p}{\omega}\right)^2 \nu_{eff}^{(1)} \tag{46}$$

where

$$\nu_{eff}^{(1)} = \frac{\alpha_2^2}{\alpha_1^3} \bar{\nu} = \bar{\nu} = 1.49 \times 10^{11} \frac{\rho}{\rho_o} = 2.14 \times 10^8 \; P_{mmHg}$$

For $\omega \ll \bar{\nu}$ for air at $T = 250°$ K (Model I)

$$\frac{T(db)}{d_{km}} = 1.447 \times 10^{-5} \frac{\omega_p^2}{\nu_{eff}^{(2)}}, \tag{47}$$

where $(\omega/\bar{\nu} = 0)$ for air (p. 111)

$$\nu_{eff}^{(2)} \equiv \nu_{DC} = \frac{\bar{\nu}}{\alpha_2 \alpha_3} = \frac{\alpha_1}{\alpha_2^2} \cdot \bar{\nu} = 0.954 \times 10^{11} \frac{\rho}{\rho_o} = 1.37 \times 10^8 \; P_{mmHg}$$

In another useful way we may write

$$\frac{T(db)}{d_{km}} = \frac{SN_e 10^{-8}}{\left(\frac{\rho}{\rho_o}\right)} , \tag{48}$$

where

$$S = \frac{46.045 \left(\frac{\rho}{\rho_o}\right)}{\bar{\nu} \cdot 10^{-11}} \cdot \frac{\alpha_2 \alpha_3}{1 + \alpha_1^2 \left(\frac{\omega}{\bar{\nu}}\right)^2} \tag{49}$$

and where N_e is the number of free electrons per cm^3 in air.

Table XVI gives effective α_1, α_2, α_3, and S as a function of $\omega/\bar{\nu}$. Also given in the table are the following functions versus $\omega/\bar{\nu}$:

$$\left.\begin{aligned} y &= \frac{\alpha_2\ \alpha_3}{1 + \alpha_1^2 \left(\frac{\omega}{\bar{\nu}}\right)^2}; \\ \eta &= \frac{\alpha_2\ \alpha_3 \left[1 + \left(\frac{\omega}{\bar{\nu}}\right)^2\right]}{1 + \alpha_1^2 \left(\frac{\omega}{\bar{\nu}}\right)^2} \end{aligned}\right\} \tag{50}$$

and S defined in Eq. 49.

Thus,

$$\frac{T(db)}{d_{km}} = 1.447 \times 10^{-5}\ \frac{\omega_p^2\ \bar{\nu}}{\omega^2 + \bar{\nu}^2} \cdot \eta = 4.604 \times 10^4\ \frac{N_e \bar{\nu}}{\omega^2 + \bar{\nu}^2} \cdot \eta, \tag{51}$$

$$= \frac{SN_e \cdot 10^{-8}}{\left(\frac{\rho}{\rho_o}\right)}$$

The computed corrections α_1, α_2, and α_3 can also be used in the presence of magnetic fields.[1] For the case when the electron concentration N_e (cm^{-3}) and the collision frequency are functions of the altitude in the earth's upper atmosphere, then (assuming slow variations of N_e and ν) the approximate attenuation from 0 to the altitude h_o (km) is

$$T(db) = 4.604 \times 10^4 \int_0^{h_o} \frac{\alpha_2(h)\ \alpha_3(h)\ N_e(h)\ \bar{\nu}(h)}{\alpha_1^2(h)\ \omega^2 + \bar{\nu}^2(h)}\, dh \tag{52}$$

and where α_1, α_2, and α_3 are functions of an altitude through their dependence on $\omega/\bar{\nu}$.

The inverse problem of finding $N_e(h)$ and $\bar{\nu}(h)$ from the radio attenuation in the ionosphere was worked out recently by various authors.[30,37,38] In actuality such methods yield only

$$N_e^{eff}(h) = N_e(h) \cdot \alpha_2(h)\, \alpha_3(h)$$

and

$$\nu^{eff}(h) = \frac{\bar{\nu}(h)}{\alpha_1^2(h)},$$

so that later the attenuation can be computed from

$$T\,(\mathrm{db}) = 4.604 \times 10^4 \cdot \int_0^{ho} \frac{N_e^{eff}(h)\, \nu^{eff}(h)}{\omega^2 + [\nu^{eff}(h)]^2}\, dh \tag{52a}$$

III. UNCERTAINTIES IN THE EVALUATION OF INTEGRALS INVOLVING ELECTRON-NEUTRAL COLLISION CROSS SECTIONS FOR MOMENTUM TRANSFER AS A FUNCTION OF ELECTRON ENERGY

The uncertainty in the electron-neutral elastic cross sections for the momentum transfer* is about $\pm\ 0.05\times 10^{-15}$ cm^2 from a given experiment (e.g., molecular beam). The initial collection of results from the various methods of measurements of cross sections by various investigators[11] and from the various methods of calculations give different values (in the range of 0 to 2 ev), e.g., a factor up to 7 for N_2, of 3 for O_2, of 2 for NO, of 3 for N, of 9 for O, of 9 for A, etc. However, after careful review one decides on the most reliable measurement and theoretical calculation. Then the remaining uncertainty at best is still $\pm\ 0.05\times 10^{-15}$ cm^2. (For air $\Delta Q = \pm\ 0.05\times 10^{-15}$ cm^2 gives $\Delta\bar{\nu} = \pm\ 0.19\times 10^{11}\ \rho/\rho_0$ at $T = 300^\circ$ K.) This limits the accuracy of integration at most to three or four significant digits. The five point Laguerre integration formula (Salzer and Zucker[9]) is definitely sufficient (see Table I) for a quick result. Table II indicates the approximate range of energy at which the cross section is needed for various temperatures for the evaluation of the electric conductivity integrals.

The effect of changing all the electron-neutral cross sections by a constant Δg_0 can be shown to be equal to the following change in the average collision frequency $\bar{\nu}$,

$$\Delta\bar{\nu} = \frac{8}{3\sqrt{\pi}} \sqrt{\frac{2kT}{m}}\ \Delta g_0\ 10^{-15}\ L_0 \left(\frac{\rho}{\rho_0}\right) \doteq 2.2258\times 10^{11}\ \Delta g \sqrt{\frac{T}{100}} \left(\frac{\rho}{\rho_0}\right)$$

where Δg_0 is the added value to all cross sections in the units of 10^{-15} cm^2.

*Review of Cross Sections[10]

TABLE I

EXAMPLES IN THE USE OF LAGUERRE FORMULA

$$I = \int_0^\infty f(W)\, e^{-W}\, dW \simeq \sum_{k=1}^{5} A_k f(W_k)$$

k	W_k	A_k
1	0.26356	0.521756
2	1.4134	0.398667
3	3.5964	7.59424×10^{-2}
4	7.0858	3.61176×10^{-3}
5	12.6408	2.33700×10^{-5}

Examples:

f(W)	exact integral	5 point formula	10 point formula
W	1	0.999997	1.000000
W^2	2	1.99998	2.000000
W^3	6	5.99991	6.000000
W^4	24	24.0000	24.0000
W^5	120	119.998	120.0000
W^6	720	719.989	720.0000
$W^{3/2}$	1.32934	1.3276	1.3291
$W^{5/2}$	3.32335	3.3242	3.3234
$W^{7/2}$	11.63173	11.6306	11.6317
$W^{9/2}$	52.3428	52.3437	52.3428
$W^{11/2}$	287.885	287.874	287.885
$W^{-1/2}$	1.7724	1.3931	1.5007 (1.5496)*
$(1+W)^{-1}$	0.5964	0.5951	0.59631
$W(1-e^{-W})^{1/2}$	0.85357	0.8516	0.85328
$W(1-e^{-2W})^{1/2}$	0.937098	0.9335	0.9366
$\ln W$	-0.5772157	-0.4535	-0.5147 (-0.5354)*
$\cosh \frac{1}{2} W$	1.33333	1.33328	1.33333
$\sin W$	0.5	0.49891	0.50000

*15 point formula.

TABLE II

ENERGIES AT WHICH CROSS SECTION ARE NEEDED
FOR THE EVALUATION OF CONDUCTIVITY INTEGRALS

(FIVE POINT LAGUERRE INTEGRATION)

E_k (in ev)

W_k	T=300°K	T=1000°K	T=2000°K	T=3000°K	T=4000°K	T=5000°K	T=6000°K	T=7000°K	T=10^4 °K
0.26356	0.00681	0.0227	0.0454	0.0681	0.0908	0.1135	0.1362	0.1589	0.2270
1.4134	0.0365	0.1218	0.2436	0.3654	0.4873	0.6091	0.7309	0.8527	1.2182
3.5964	0.0929	0.3099	0.6198	0.9297	1.240	1.549	1.859	2.169	3.099
7.0858	0.1831	0.6105	1.2210	1.8315	2.4420	3.0525	3.6630	4.2735	6.105
12.6408	1.327	1.089	2.178	3.267	4.357	5.446	6.535	7.624	10.892

$$E_k(\text{in ev}) = \frac{W_k}{1.1606} T \times 10^{-4}$$

(The 10 point formula gives energy range greater by about a factor of two.)

From examination of W^2e^{-W} graph, the main contribution to the integral of collision frequency will come from (no resonance of Q outside this energy range):

T = 300°K	$0.005 \lesssim E \lesssim 0.2$ ev
T = 3000°K	$0.05 \lesssim E \lesssim 2$ ev
T = 6000°K	$0.1 \lesssim E \lesssim 4$ ev
T = 10^4 °K	$0.15 \lesssim E \lesssim 7$ ev

In Table III we list cross sections (mean experimental and theoretical values) with an assumed accuracy of $\pm$ 0.001x10^{-15} cm^2 which gives for collision frequency of air at the best:

Model I

T, °K	$\nu\left(\frac{\rho}{\rho_o}\right)^{-1} \cdot 10^{-11}$, sec^{-1}
200	1.200 $\pm$ 0.003
250	1.491 $\pm$ 0.004
300	1.777 $\pm$ 0.004
350	2.055 $\pm$ 0.004

As an upper bound variation in the cross-section data we may take the experimental uncertainty (within a given experiment) Δg_o = $\pm$0.05x 10^{-15} cm^2 which would give (Model I) for air

T, °K	$\bar{\nu}\left(\frac{\rho}{\rho_o}\right)^{-1} \cdot 10^{-11}$, sec^{-1}	$\bar{\nu}\ P^{-1}_{mmHg} \cdot 10^{-8}$, sec^{-1}
200	1.20 $\pm$ 0.16	2.16 $\pm$ 0.28
250	1.49 $\pm$ 0.18	2.14 $\pm$ 0.25
300	1.78 $\pm$ 0.19	2.13 $\pm$ 0.23
350	2.05 $\pm$ 0.21	2.11 $\pm$ 0.21

The change in the effective α's due to change in the cross sections can be obtained only by a repeated numerical integration.

IV. REVIEW OF CROSS SECTIONS AND DESCRIPTION OF TWO MODELS USED

After the report was completed (Model I) we found a new experimental value of electron - O_2 elastic cross section for the momentum transfer below 1 ev in the report by Phelps,[12] and we recomputed collision frequencies and corrections to electric conductivity for O_2 and for air (Model II). Just before publication of this report we found out from private communication by Phelps[36] that his "new" cross section was wrong. We decided to keep the wrong result (Model II) in the report* in order to illustrate the drastic effect on the collision frequency at low temperatures and as an upper bound of collision frequency. The cross sections below 1 ev are known to have a rather violent history, both in the value and in the shape, which only after prolonged and repeated measurements by different methods and detailed calculations converge to some accepted value. Therefore, if any changes should occur in the future, Model II could be of some interpretative value.

All computations in this report were performed using numerical integration method (Simpson's) and the cross sections were given at a closely spaced even interval (see Table III) and interpolated wherever needed in numerical integration. Formulae for cross section for O_2 (in Model II) and for N_2 (in Model I and in Model II) were used for a special energy range (see pp. 24 and 25).

* See Appendix, p. 152, Figs. 7 and 9.

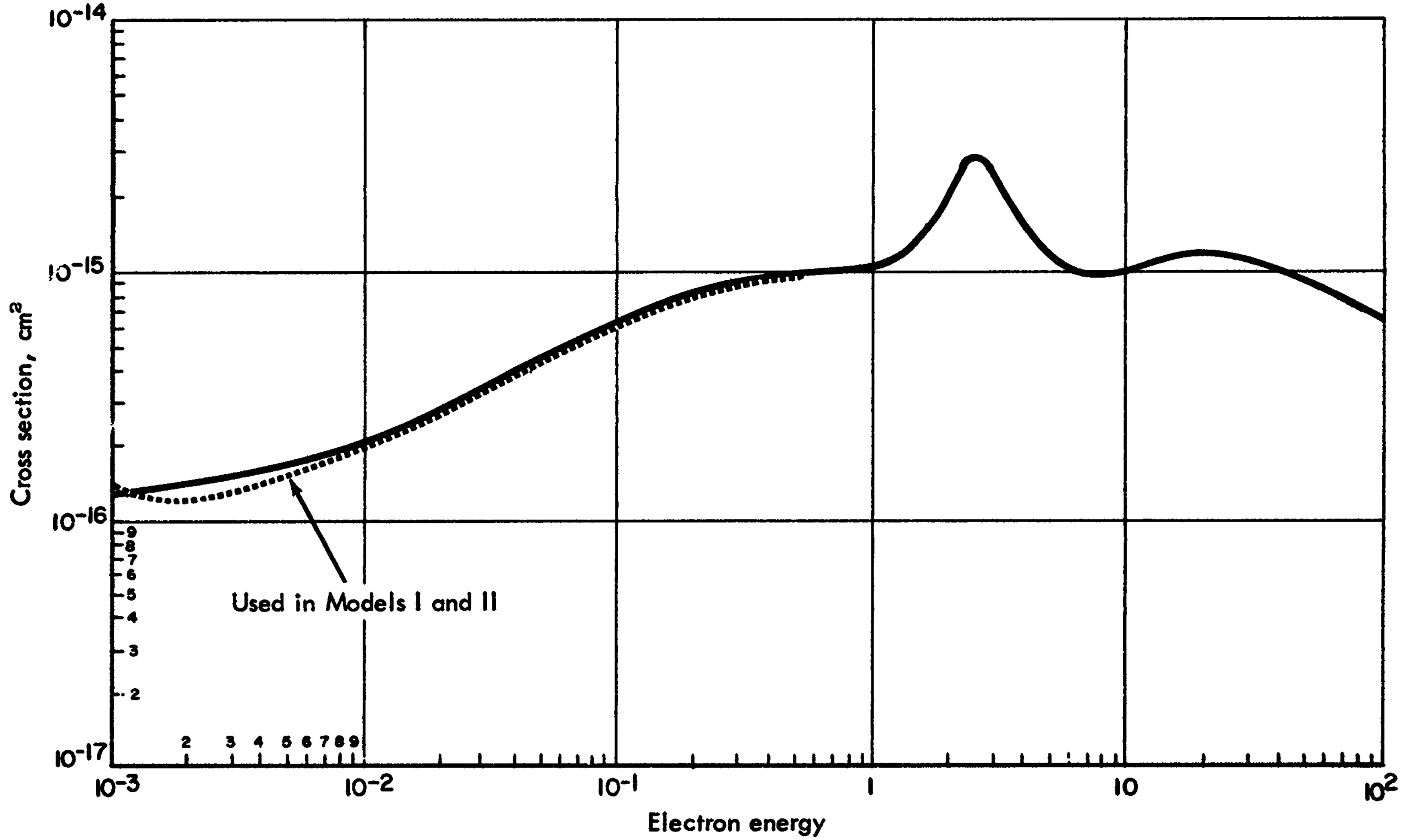


FIGURE 1 Electron Momentum Transfer Cross Section for N_2 (from Phelps, Ref. 14)

R4-21-64-9

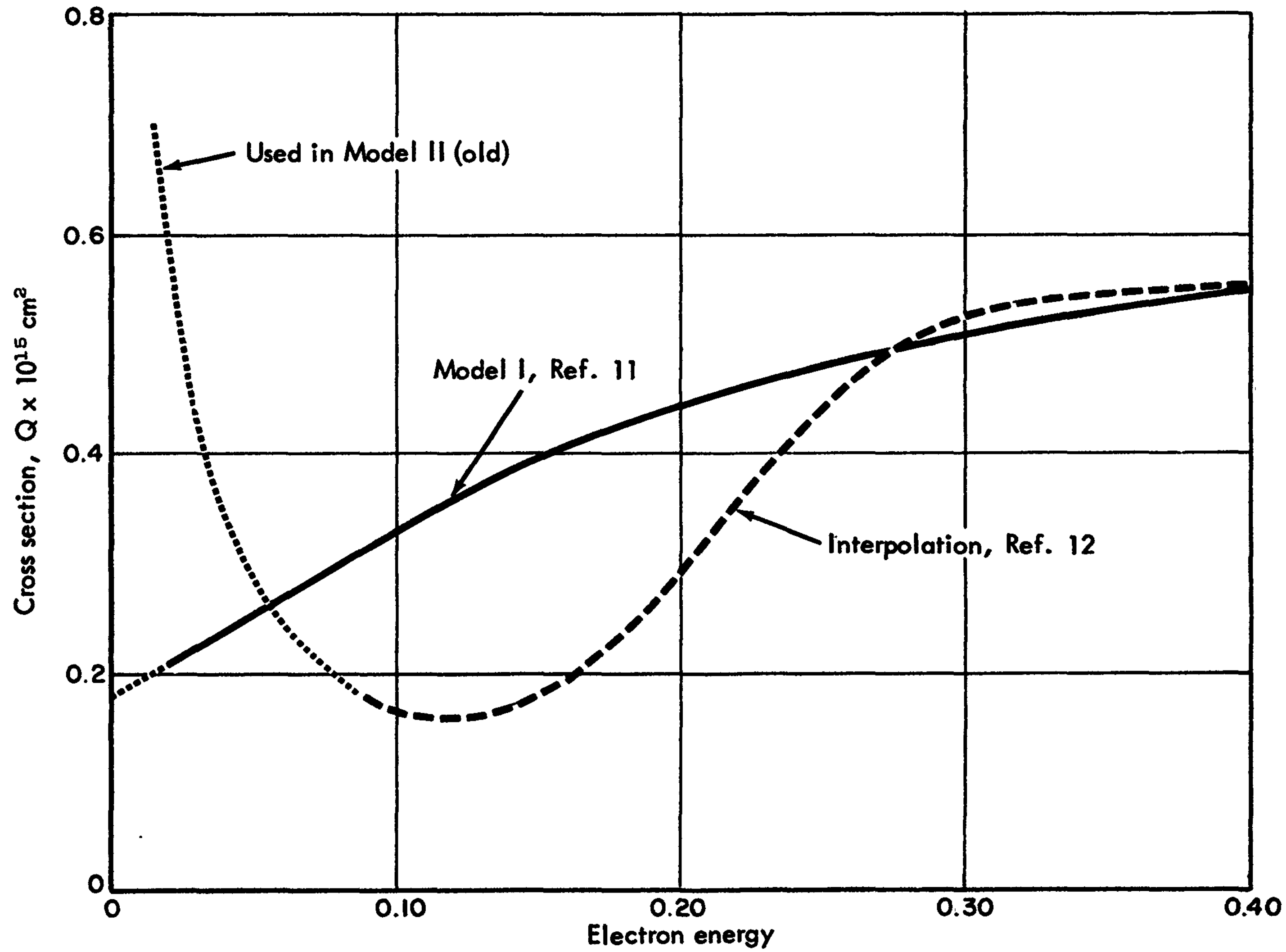
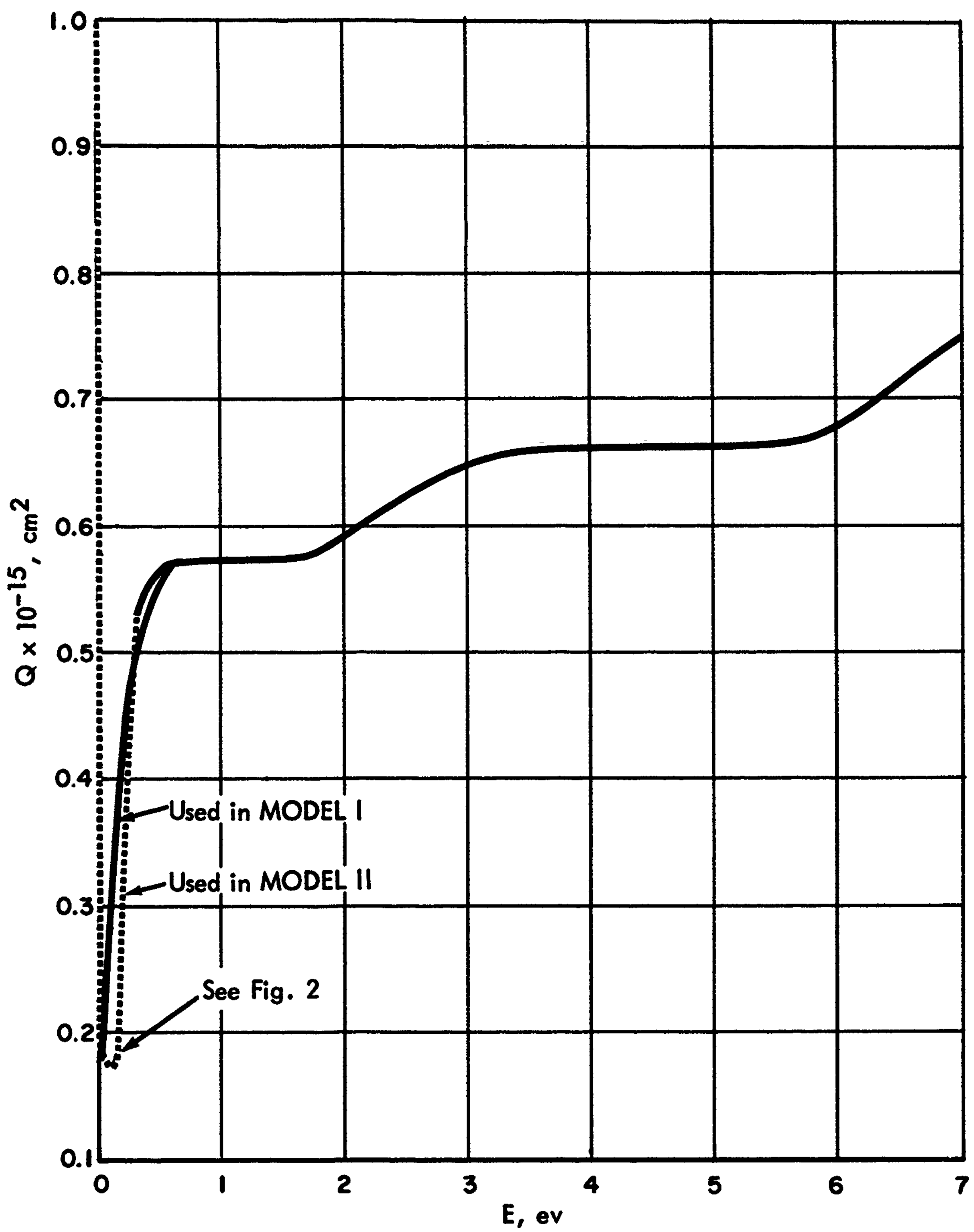


FIGURE 2 Electron Momentum Transfer Cross Section for O_2
(σ_2 from Phelps, Ref. 12, Model II; Model I from Ref. 11)



(Based on Refs. 11, 12, and Brüche, Ref. 18)

FIGURE 3 Electron Momentum Transfer Cross Section for O_2

RI2-4-64-I

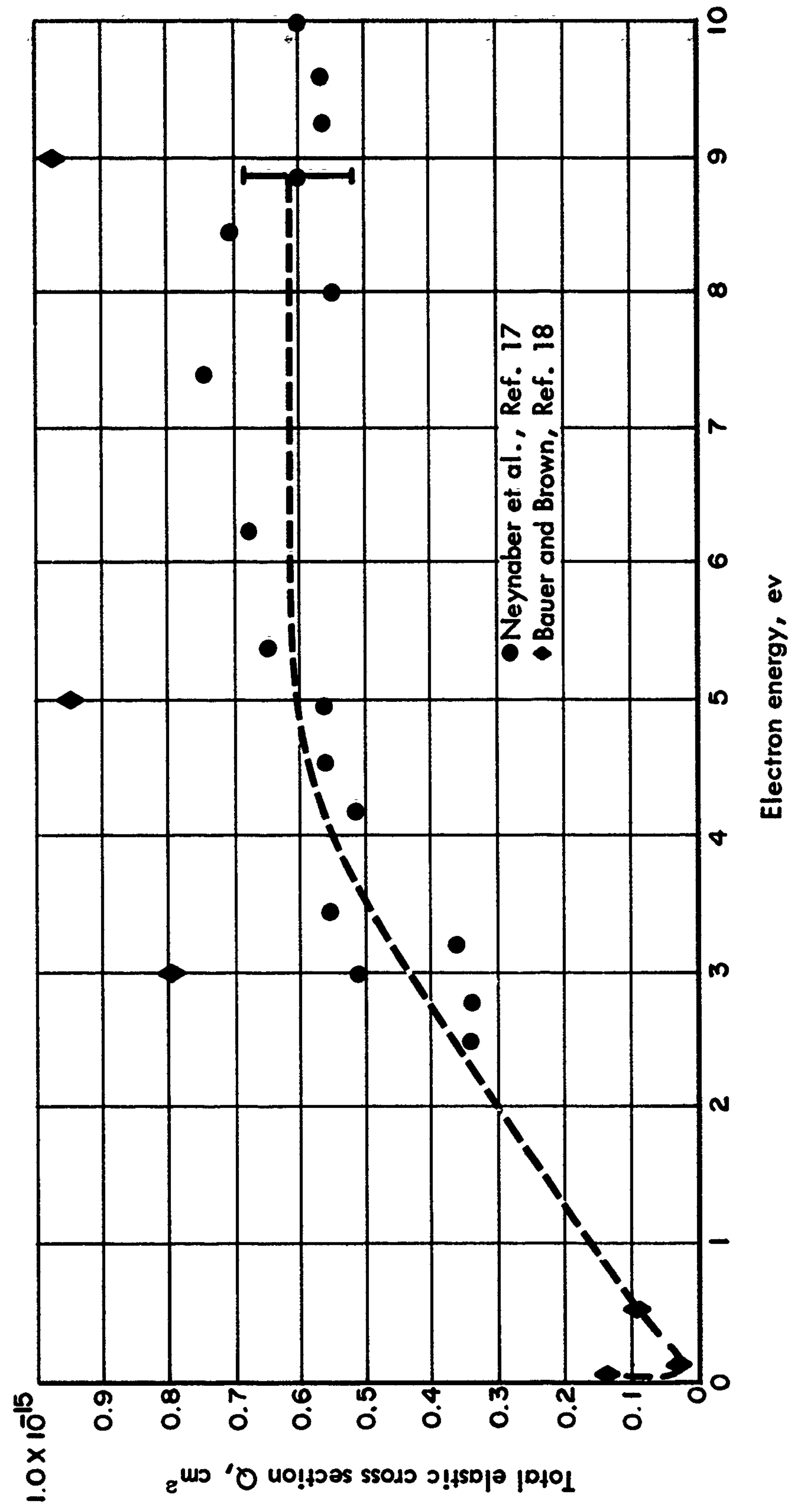


FIGURE 4 Total Elastic Cross Section for Electrons with Atomic Nitrogen

R12-4-64-2

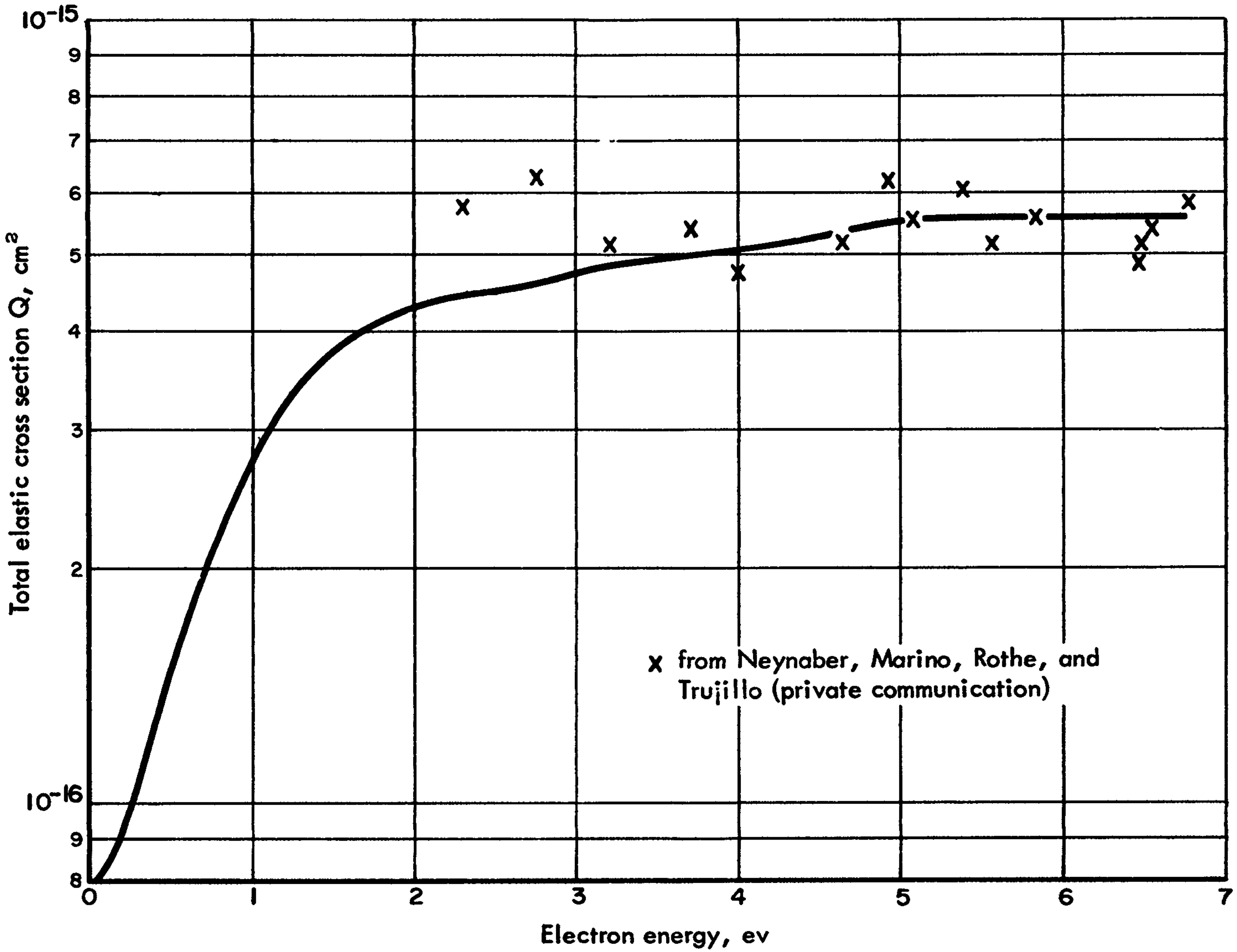


FIGURE 5 Total Elastic Cross Section for Electrons with Atomic Oxygen (Refs. 22 and 24)

R12-4-64-3

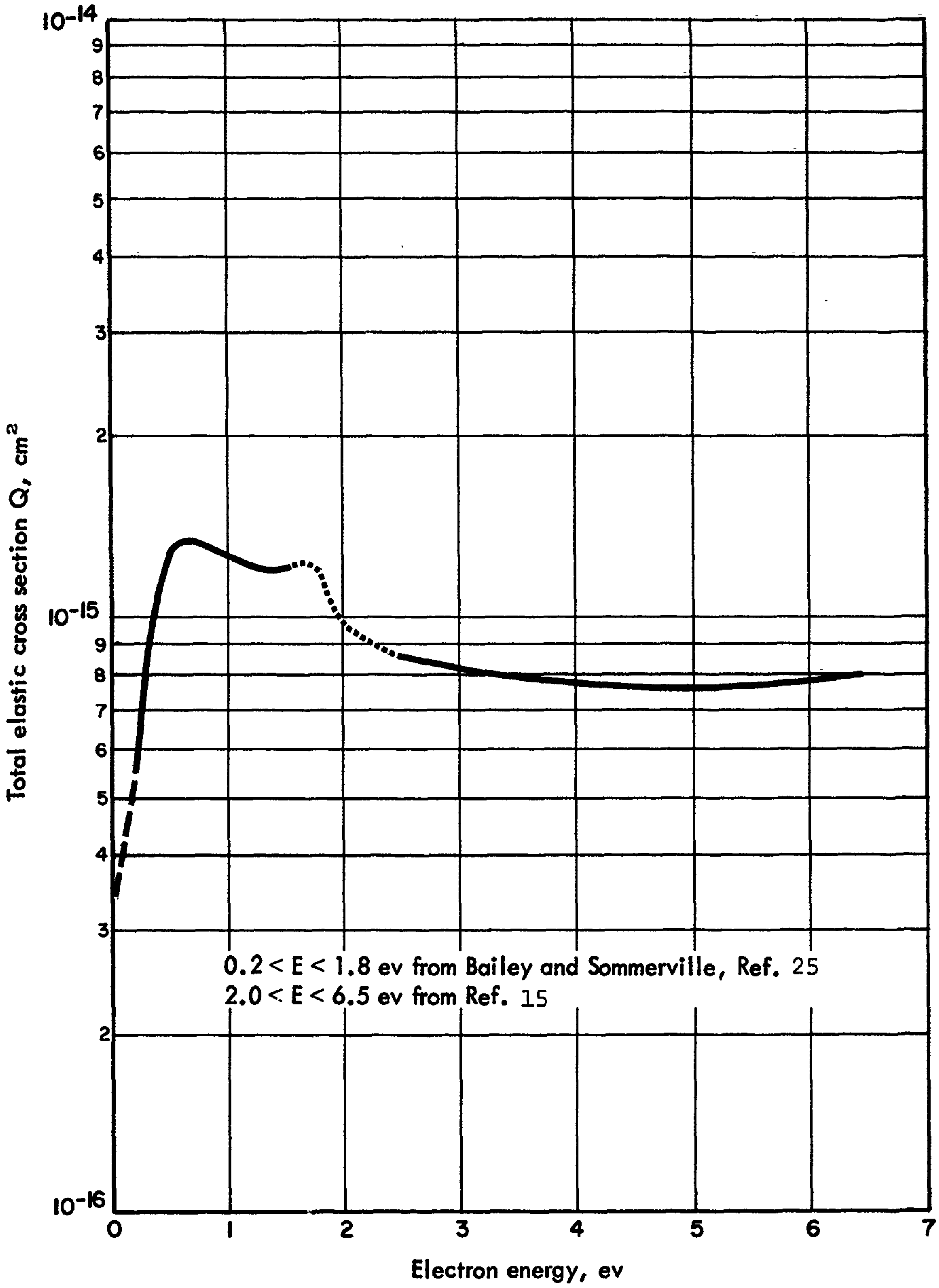


FIGURE 6 Total Elastic Cross Section for Electrons with NO

RI2-4-64-4

Comments on the Adapted Values (for the numerical integration) of Electron Momentum Transfer Cross Sections*

For O_2:

$0.025 \le E \le 1.8$ ev	From review by Shkarofsky, Bachynski, and Johnson[11] (1961).
(Used in Model I and for $E > 0.4$ ev used in Model II)	[Based on private communication to Shkarofsky et al. by R.W. Crompton and L.G.H. Huxley (subject to a correct distribution) using data of R.A. Nielsen and N.E. Bradbury, Phys. Rev. 51, 69 (1937).] The numbers were read from Fig. 2a in Ref. 11 and extrapolated to energies below 0.025 ev.
$0.01 \le E \le 0.09$ ev (Used in Model II)	Phelps[12] (1963). His $Q_2 = 0.0305\times10^{-15}/E_{ev}^{3/4}$ was used.**
$0.09 \le E \le 0.04$ ev (Used in Model II)	Extrapolated by Phelps.[12] Read from his graph. See our Fig. 2.**
$0 \le E \le 0.01$ (Used in Model II)	Linear interpolation from 1963 Phelps[12] value** (see above) to our guessed value at E = 0 of $Q = 1.0\times10^{-15}$ cm^2. (In calculating collision frequency we multiply Q by $v^5 e^{-mv^2/2kT}$ and integrate, i.e., this guessed value will result in a small error to the total integral as long as Q does not go faster to infinity at zero velocity as $1/v^5$.)
$1.8 \le E \le 6.8$ ev	Brüche[18] (1927). Shape verified by Neynaber et al.[24] (1961).

For N_2:

$3\times10^{-3} < E < 0.05$ ev	Data by Pack and Phelps[13] (1961) are given by the formula.

* Detailed review for all elements is in preparation.[10]

** According to latest private communication by Phelps,[36] his experimental $Q(O_2)$ (used in Model II) was wrong. Can be used as upper bound.

For N_2 (cont):

$$Q = \frac{10^{-15}\sqrt{E_{ev}}}{0.531 - 3.15\text{x}10^{-4}/E_{ev}}\ \text{cm}^2 ,$$

this gives $Q = 0.426\text{x}10^{-15}\text{cm}^2$ at $E = 0.05$ ev
$Q = 0.129\text{x}10^{-15}$ at $E = 0.003$ ev.

$0 \le E < 3\text{x}10^{-3}$ ev — By taking straight line approximation, so that its slope is equal to the slope given by above formula at E = 0.003 ev, we obtained

$Q = 0.0945\text{x}10^{-15}$ at $E = 0$

(See previous comment for Q at E = 0 of O_2)

$0.1 < E < 1.75$ ev — Based on R.W. Crompton and L.G.H. Huxley [private communication to Shkarofsky et al (1961)], who used data of R.A. Nielsen, Phys. Rev. 50, 950 (1936). Read from graph in Ref. 11.

$0.01 < E \le 7$ ev — Recent data by Phelps[14,26] (1963 to 1964) are in perfect agreement with above (see slight departure in our Fig. 1, which has no noticeable effect on the collision frequency).

For O:

$0 \le E \le 2$ ev — From graph in Bates and Massey[22] (1947), with added p-wave contribution from Klein and Brueckner[23] (1958), according to Neynaber et al[24] (1961), through a point by Lin and Kivel (1959).

$2 \le E \le 5$ ev — The above theoretical data was joined smoothly to the following cross-section:

$5 \le E \le 11$ ev — From experiment by Neynaber, Marino, Rothe and Trujilo[24] (1961), (measured by $2.3 \le E \le 11.6$ ev)

$$Q = (5.5 \pm 0.4) \times 10^{-15}\ \text{cm}^2.$$

	(Actually they measured the ratio of $Q(O)/Q(O_2)$ and used values for $Q(O_2)$ of E. Brüche[19] (1927).
<u>For N:</u>	
2.5 - 10 ev	Neynaber, Marino, Rothe and Trujilo[17] (1963) [actually measured ratio of $Q(N)/Q(N_2)$ and used $Q(N_2)$ from Normand[21]].
0.1 - 0.5 ev	Bauer and Browne[18] (1963)
0.5 - 2 ev	Joined smoothly between Refs. 17 and 18.
<u>For NO:</u>	
0.2 ev - 1.8 ev	Based on Bailey and Sommerville[25] (1934), chosen on recommendation of Ref. 11 (their curve 6).
0 - 0.2 ev	Extrapolated from above.
2 ev - 6.5 ev	Read from graph in Massey and Burhop[15] (1956). Based on data obtained by Ramsauer method.
1.8 ev - 2.0 ev	Joined smoothly between values from Refs. 15 and 11.
<u>For A:</u>	
0 < E	Pack and Phelps[13] (1961), and Engelhardt and Phelps[16] (1964). Argon was used for air for $T \leq 2000^{\circ}$ only.

TABLE III

ADAPTED FOR CALCULATIONS
ELECTRON-NEUTRAL COLLISION CROSS SECTIONS FOR MOMENTUM TRANSFER AS A FUNCTION OF ELECTRON ENERGY

(Q in units of $10^{-15}cm^2$)

E(ev)	$Q(O_2)$*	$Q(N_2)$	Q(NO)	Q(N)	Q(O)
0.00	(0.177)	(0.0945)	(0.30)	0.200	0.0792
0.05	0.255	0.425	(0.35)	.050	.0800
0.10	0.333	0.625	(0.40)	.020	.0820
0.15	0.398	0.720	(0.46)	.030	.0880
0.20	0.437	0.789	0.525	0.038	0.0924
0.25	0.475	0.839	0.626	.048	.1000
0.30	0.505	0.875	0.805	.056	.1080
0.35	0.525	0.907	0.890	.062	.1170
0.40	0.545	0.937	1.015	0.073	0.1276
0.45	0.558	0.957	1.124	.085	.1390
0.50	0.570	0.975	1.220	.095	.1500
0.55	0.575	0.990	1.288	.100	.1610
0.60	0.579	1.005	1.320	0.105	0.1716
0.65	0.577	1.020	1.335	.113	.1840
0.70		1.032	1.340	.121	.1950
0.75		1.042	1.337	.129	.2050
0.80		1.052	1.327	0.135	0.2156
0.85		1.065	1.315	.142	.2280
0.90		1.080	1.298	.150	.2410
0.95		1.095	1.272	.158	.2530
1.00		1.115	1.268	0.164	0.2640
1.05		1.130	1.254	.171	.2780
1.10		1.152	1.240	.179	.2930
1.15		1.172	1.228	.184	.3080
1.20		1.195	1.218	0.190	0.3212
1.25		1.217	1.210	.198	.3320
1.30		1.240	1.206	.203	.3420
1.35		1.262	1.204	.209	.3510
1.40		1.282	1.204	0.217	0.3608
1.45		1.305	1.206	.220	.3690
1.50		1.325	1.215	.227	.3770
1.55		1.344	1.222	.231	.3840
1.60	↓	1.410	1.230	0.239	0.3916
1.65		1.490	1.239	.246	.3980
1.70	0.577	1.570	1.250	.251	.4020

* Model I

E(ev)	$Q(O_2)$	$Q(N_2)$	Q(NO)	Q(N)	Q(O)
1.75	0.577	1.640	1.264	.260	.407
1.80	0.577	1.700	1.276	0.267	0.4092
1.85	0.585	1.78	1.25	.271	.416
1.90	0.587	1.82	1.075	.279	.419
1.95	0.590	1.92	1.025	.287	.421
2.00	0.592	2.00	0.98	0.294	0.422
2.05	0.596	2.10	0.95	.300	.428
2.10	0.599	2.21	0.93	.307	.430
2.15	0.603	2.32	0.915	.312	.434
2.20	0.606	2.40	0.90	0.319	0.440
2.25	0.610	2.45	0.881	.327	.440
2.30	0.613	2.48	0.88	.331	.441
2.35	0.616	2.49	0.875	.340	.441
2.40	0.619	2.50	0.87	0.348	0.442
2.45	0.622	2.50	0.865	.351	.443
2.50	0.625	2.50	0.860	.359	.445
2.55	0.628	2.49	0.855	.368	.447
2.60	0.631	2.46	0.850	0.373	0.449
2.65	0.633	2.43	0.850	.379	.451
2.70	0.636	2.39	0.849	.385	.454
2.75	0.638	2.35	0.840	.391	.456
2.80	0.640	2.29	0.835	0.400	0.458
2.85	0.642	2.23	0.832	.406	.463
2.90	0.644	2.16	0.830	.411	.468
2.95	0.646	2.08	0.825	.419	.470
3.00	0.647	2.00	0.820	0.426	0.475
3.05	0.648	1.93	0.817	.431	.476
3.10	0.650	1.86	0.815	.440	.478
3.15	0.651	1.80	0.813	.447	.479
3.20	0.653	1.75	0.810	0.452	0.480
3.25	0.654	1.69	0.809	.460	.481
3.30	0.655	1.64	0.805	.467	.482
3.35	0.656	1.58	0.802	.472	.485
3.40	0.657	1.53	0.800	0.480	0.488
3.45	0.658	1.48	0.795	.485	.489
3.50	0.658	1.43	0.790	.492	.490
3.55	0.659	1.37	0.790	.497	.491
3.60	0.659	1.32	0.790	0.503	0.493
3.65	0.659	1.26	0.790	.510	.495
3.70	0.660	1.22	0.790	.516	.497
3.75	0.660	1.18	0.790	.520	.499
3.80	0.660	1.13	0.785	0.527	0.501
3.85	0.660	1.09	0.780	.530	.503
3.90	0.660	1.06	0.775	.535	.506
3.95	0.660	1.00	0.770	.540	.508
4.00	0.660	.990	0.766	0.545	0.510
4.05	0.660	.980	0.766	0.550	0.510

E(ev)	$Q(O_2)$	$Q(N_2)$	Q(NO)	Q(N)	Q(O)
4.10	0.660	.960	0.766	0.5555	0.511
4.15	0.660	.960	0.766	.559	.511
4.20	0.660	.950	0.766	0.563	0.512
4.25	0.660	.950	0.766	.567	.516
4.30	0.660	.950	0.766	.567	.519
4.35	0.660	.950	0.766	.570	.523
4.40	0.660	.950	0.766	0.577	0.526
4.45	0.660	.950	0.766	.580	.528
4.50	0.660	.950	0.766	.584	.530
4.55	0.660	.950	0.766	.587	.533
4.60	0.660	.960	0.766	0.588	0.536
4.65	0.660	.960	0.766	.591	.538
4.70	0.660	.960	0.766	.593	.540
4.75	0.660	.970	0.7625	.597	.542
4.80	0.660	.970	0.7650	0.598	0.544
4.85	0.660	.980	0.7675	.599	.547
4.90	0.660	.980	0.770	.600	.548
4.95	0.660	.990	0.7725	.601	.549
5.00	0.660	1.00	0.775	0.601	0.550
5.05	0.660	.990	0.7775	.601	.550
5.10	0.660	.990	0.780	.602	.550
5.15	0.661	.990	0.782	.602	.550
5.20	0.661	.990	0.7835	0.602	0.550
5.25	0.6615	.990	0.785	.602	.550
5.30	0.662	.990	0.7865	.602	.550
5.35	0.6625	.990	0.788	.602	.550
5.40	0.663	.980	0.790	0.602	0.550
5.45	0.664	.980	0.790	.602	.550
5.50	0.6646	.980	0.791	.602	.550
5.55	0.6653	.980	0.7915	.603	.550
5.60	0.666	.980	0.792	0.603	0.550
5.65	0.668	.980	0.7925	.603	.550
5.70	0.6695	.980	0.793	.603	.550
5.75	0.671	.980	0.794	.603	.550
5.80	0.673	.980	0.795	0.604	0.550
5.85	0.675	.980	0.7975	.604	.550
5.90	0.677	.980	0.800	.604	.550
5.95	0.680	.980	0.8025	.604	.550
6.00	0.683	.980	0.805	0.604	0.550
6.05	0.686	.980	0.8075	.604	.550
6.10	0.689	.980	0.810	.605	.550
6.15	0.693	.980	0.810	.605	.550
6.20	0.696	.980	0.810	0.605	0.550
6.25	0.701	.980	0.810	.605	.550
6.30	0.705	.980	0.810	.606	.550
6.35	0.709	.980	0.810	.606	.550
6.40	0.713	.980	0.810	0.606	0.550

E(ev)	$Q(O_2)$	$Q(N_2)$	Q(NO)	Q(N)	Q(O)
6.45	0.717	.980	0.81	0.607	0.550
6.50	0.722	.980	0.81	.608	.550
6.55	0.726	.980	0.81	.608	.550
6.60	0.730	.980	0.81	0.609	0.550
6.65	0.734	.980	0.81	.609	.550
6.70	0.738	.990	0.81	.609	.550
6.75	0.742	.990	0.81	.610	.550

V. AVERAGE COLLISION FREQUENCIES FOR WEAKLY IONIZED N_2, O_2, NO, N, O, DRY AIR AND ARGON

($\omega >> \nu$)

For $\omega >> \nu$, we have from Eq. 29

$$\bar{\nu} = \frac{4}{3\sqrt{\pi}} \int_0^\infty \nu(W)\, W\sqrt{W}\, e^{-W} dW \quad , \qquad W = \frac{1}{2}\frac{mv^2}{kT}$$

$$E_{ev} = W \cdot \frac{T \cdot 10^{-4}}{1.1606}$$

where

$$N(cm^{-3}) = L_0\ \rho/\rho_0 \quad , \quad L_0 = 2.6871 x 10^{19} \quad ,$$

$$T_0 = 273.16^oK \quad , \quad P_0 = 1 \text{ atm},$$

$$P_{mm\,Hg} = 760(\rho/\rho_0)T/273.16 \quad .$$

$\rho_0(N_2) = 1.250 x 10^{-3}$ gm/cm^3 ; ρ_0(dry air) $= 1.223 x 10^{-3}$ gm/cm^3

$\rho_0(O_2) = 1.428 x 10^{-3}$ gm/cm^3 ; ρ_0(h.temp.air) $= 1.293 x 10^{-3}$ gm/cm^3

Dry air: 78.0881% N_2 ; 20.9795% O_2 ; 0.9324% A.

High temp. air: 78.084% N_2 ; 20.946% O_2; 0.937% A; 0.033% CO_2 (only concentrations of N_2, O_2, N, O, NO and electrons were used).

For i-th species:

$$\bar{\nu}(i) = \bar{\nu}_0^{(i)} \cdot 10^{11}\ C_i\ \frac{\rho}{\rho_0} = \bar{\nu}_1^{(i)}\ 10^8 P^{(i)}_{mm\,Hg} = \bar{\nu}_2^{(i)}\ 10^{-8}\ N^{(i)}_{cm^{-3}} \quad ,$$

where $\bar{\nu}_0$, $\bar{\nu}_1$ and $\bar{\nu}_2$ are factors tabulated in the next tables and where

$$\bar{\nu}_2^{(i)} = \bar{\nu}_0^{(i)}/2.6871 \quad .$$

TABLE IV

AVERAGE ELECTRON COLLISION FREQUENCY
FOR WEAKLY IONIZED DIATOMIC NITROGEN

$(\omega \gg \nu)$

$$\bar{\nu}_{e,n}(N_2) = \bar{\nu}_0 \cdot 10^{11} \frac{\rho}{\rho_0} = \bar{\nu}_1 \cdot 10^{8} P_{mmHg} = \bar{\nu}_2 \cdot 10^{-8} N_{N_2} \text{ , sec}^{-1}$$

T, °K	$\bar{\nu}_0$	$\bar{\nu}_1$	$\bar{\nu}_2$
100	0.664	2.388	0.2471
200	1.319	2.371	0.4909
210	1.385	2.371	0.5154
220	1.451	2.371	0.5400
230	1.517	2.370	0.5645
240	1.582	2.370	0.5887
250	1.648	2.369	0.6133
260	1.713	2.368	0.6375
270	1.778	2.366	0.6617
280	1.842	2.364	0.6855
290	1.906	2.362	0.7093
300	1.970	2.360	0.7331
310	2.033	2.357	0.7566
320	2.096	2.354	0.7800
330	2.159	2.351	0.8035
340	2.221	2.348	0.8265
350	2.283	2.344	0.8496
360	2.344	2.340	0.8723
370	2.405	2.336	0.8950
380	2.466	2.332	0.9177
390	2.526	2.328	0.9400
400	2.586	2.323	0.9624
500	3.163	2.274	1.177
600	3.706	2.220	1.379
700	4.219	2.166	1.570
800	4.706	2.114	1.751
1000	5.618	2.019	2.091
1200	6.460	1.935	2.404
1400	7.251	1.862	2.698
1600	8.003	1.798	2.978
1800	8.728	1.743	3.248
2000	9.436	1.696	3.512

Note: In all tables only two significant digits can be expected to be accurate; the remaining two digits are included for smoothness and for comparison studies of effects of change in cross sections on collision frequency (see pg. 16).

TABLE IV (Cont.)

AVERAGE ELECTRON COLLISION FREQUENCY
FOR WEAKLY IONIZED DIATOMIC NITROGEN

($\omega \gg \nu$)

T, °K	$\bar{\nu}_0$	$\bar{\nu}_1$	$\bar{\nu}_2$
2500	11.19	1.610	4.164
3000	13.02	1.560	4.845
3500	14.96	1.536	5.567
4000	17.00	1.527	6.326
4500	19.07	1.523	7.097
5000	21.15	1.520	7.871
5500	23.15	1.513	8.615
6000	25.04	1.500	9.319
6500	26.79	1.481	9.997
7000	28.38	1.457	10.56
7500	29.82	1.429	11.10
8000	31.10	1.397	11.57
8500	32.25	1.364	12.00
9000	33.25	1.328	12.37
9500	34.14	1.292	12.71
10000	34.89	1.254	12.98

N_{N_2} - number of N_2 molecules per cm^3.

TABLE V

AVERAGE ELECTRON COLLISION FREQUENCY FOR WEAKLY IONIZED DIATOMIC OXYGEN (MODEL I)

$(\omega >> \nu)$

100% O_2; $\rho_o = 1.428 \times 10^{-3}$ gm/cm^3

$$\bar{\nu}_{e,n}(O_2),\ \sec^{-1} = \bar{\nu}_0 \cdot 10^{11} \frac{\rho}{\rho_0} = \bar{\nu}_1 \cdot 10^8 P^{(O_2)}_{mmHg} =$$

$$\bar{\nu}_2 \cdot 10^{-8} N_{O_2}(cm^{-3})$$

T, °K	$\bar{\nu}_0$	$\bar{\nu}_1$	$\bar{\nu}_2$
200	0.811	1.16	0.302
210	0 844	1.444	0.314
220	0.876	1.432	0.326
230	0.909	1.421	0.338
240	0.942	1.411	0.351
250	0.975	1.401	0.363
260	1.007	1.392	0.374
270	1.040	1.384	0.3870
280	1.072	1.377	0.3990
290	1.105	1.370	0.4112
300	1.138	1.363	0.4235
310	1.170	1.357	0.4354
320	1.202	1.351	0.4473
330	1.235	1.345	0.4596
340	1.267	1.339	0.4715
350	1.299	1.334	0.4834
360	1.331	1.329	0.4953
370	1.363	1.324	0.5072
380	1.396	1.320	0.5195
390	1.427	1.315	0.5311
400	1.459	1.311	0.5430
500	1.772	1.274	0.6594
600	2.075	1.243	0.7722
700	2.367	1.215	0.8809
800	2.649	1.190	0.9858
900	2.919	1.166	1.086
1000	3.179	1.143	1.183
1200	3.667	1.099	1.365
1400	4.117	1.057	1.532
1600	4.531	1.018	1.686
1800	4.915	0.9814	1.829
2000	5.271	0.9473	1.962

TABLE V (Cont., O_2)

T, ^{o}K	$\bar{\nu}_0$	$\bar{\nu}_1$	$\bar{\nu}_2$
2500	6.073	0.8731	2.260
3000	6.776	0.8118	2.522
3500	7.412	0.7612	2.758
4000	8.003	0.7192	2.978
4500	8.562	0.6838	3.186
5000	9.097	0.6539	3.385
5500	9.612	0.6281	3.577
6000	10.11	0.6057	3.762
6500	10.60	0.5861	3.945
7000	11.07	0.5687	4.120
7500	11.54	0.5530	4.295
8000	11.99	0.5388	4.462
8500	12.44	0.5260	4.630
9000	12.88	0.5142	4.793
9500	13.31	0.5034	4.953
10000	13.73	0.4934	5.110

N_{O_2} - number of O_2 molecules in 1 cm^3.

TABLE VI

AVERAGE ELECTRON COLLISION FREQUENCY
FOR NO

$(\omega \gg \nu)$

$$\bar{\nu}_{e,n}(NO) = \bar{\nu}_o \cdot 10^{11} C_{NO} \frac{\rho}{\rho_o} = \bar{\nu}_1 \cdot 10^8 P^{(NO)}_{mmHg} = \bar{\nu}_2 \cdot 10^{-8} N_{NO} \text{ , sec}^{-1}$$

T, °K	$\bar{\nu}_o$	$\bar{\nu}_1$	$\bar{\nu}_2$
150	0.922	2.210	0.343
200	1.108	1.991	0.4123
250	1.287	1.851	0.4790
300	1.466	1.756	0.5456
350	1.647	1.692	0.6129
400	1.835	1.649	0.6829
450	2.031	1.622	0.7558
500	2.238	1.609	0.8329
550	2.455	1.605	0.9136
600	2.684	1.608	0.9988
650	2.924	1.620	1.088
700	3.173	1.630	1.181
750	3.432	1.645	1.277
800	3.700	1.662	1.377
850	3.972	1.680	1.478
900	4.251	1.698	1.582
950	4.535	1.716	1.688
1000	4.821	1.733	1.794
1100	5.400	1.764	2.010
1200	5.979	1.791	2.225
1300	6.553	1.812	2.439
1400	7.119	1.828	2.649
1500	7.671	1.838	2.855
1600	8.209	1.844	3.055
1700	8.729	1.846	3.248
1800	9.231	1.843	3.435
1900	9.717	1.838	3.616
2000	10.18	1.830	3.788
2500	12.25	1.762	4.559
3000	13.95	1.671	5.191
3500	15.33	1.574	5.705
4000	16.46	1.479	6.125
4500	17.38	1.388	6.468

TABLE VI (Contd., NO)

$T, ^oK$	$\bar{\nu}_0$	$\bar{\nu}_1$	$\bar{\nu}_2$
5000	18.14	1.304	6.751
5500	18.78	1.227	6.989
6000	19.32	1.157	7.190
6500	19.77	1.094	7.357
7000	20.17	1.036	7.506
7500	20.53	0.9838	7.640
8000	20.85	0.9368	7.759
8500	21.15	0.8943	7.871
9000	21.42	0.8555	7.971
9500	21.68	0.8204	8.068
10000	21.94	0.7885	8.165

N_{NO} - number of NO molecules per cm^3.

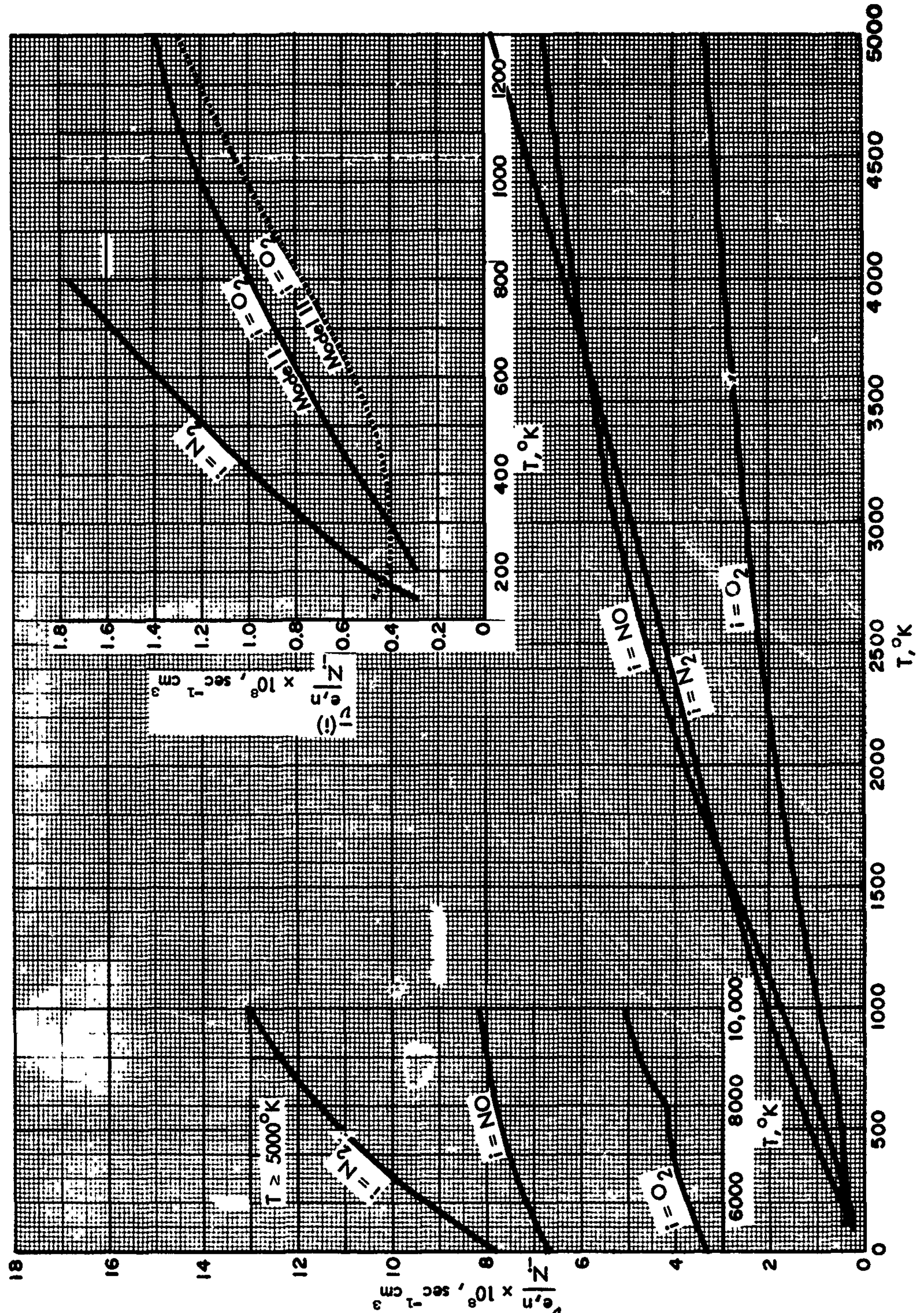


FIGURE 7 Average Electron Collision Frequency for Weakly Ionized N_2, O_2, and NO ($\omega >> \nu$)

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TABLE VII

AVERAGE ELECTRON COLLISION FREQUENCY
FOR ATOMIC NITROGEN

$(\omega \gg \nu)$

$$\bar{\nu}_{e,n}(N) = \bar{\nu}_o \cdot 10^{11} C_N \frac{\rho}{\rho_o} = \bar{\nu}_1 \cdot 10^8 P_{mmHg}^{(N)} = \bar{\nu}_2 \cdot 10^{-8} N_N \quad , \text{sec}^{-1}$$

T, °K	$\bar{\nu}_o$	$\bar{\nu}_1$	$\bar{\nu}_2$
1500	0.6134	0.1470	0.2283
1600	0.6696	0.1504	0.2492
1700	0.7271	0.1537	0.2706
1800	0.7858	0.1569	0.2924
1900	0.8458	0.1600	0.3147
2000	0.9070	0.1630	0.3375
2500	1.227	0.1765	0.4566
3000	1.570	0.1881	0.5843
3500	1.934	0.1986	0.7197
4000	2.316	0.2081	0.8619
4500	2.715	0.2169	1.010
5000	3.134	0.2252	1.166
5500	3.567	0.2331	1.327
6000	4.012	0.2404	1.493
6500	4.469	0.2471	1.663
7000	4.935	0.2534	1.836
7500	5.407	0.2591	2.012
8000	5.883	0.2643	2.189
8500	6.362	0.2690	2.367
9000	6.840	0.2732	2.545
9500	7.318	0.2769	2.723
10000	7.794	0.2801	2.900

N_N - number of nitrogen atoms per cm^3.

TABLE VIII

AVERAGE ELECTRON COLLISION FREQUENCY FOR ATOMIC OXYGEN

$(\omega >> \nu)$

$$\bar{\nu}_{e,n}(O) = \bar{\nu}_O \cdot 10^{11} \cdot C_O \frac{\rho}{\rho_O} = \bar{\nu}_1 \cdot 10^{8} \cdot P^{(O)}_{mmHg} = \bar{\nu}_2 \cdot 10^{-8} N_O \quad , \quad sec^{-1}$$

$T, {}^{o}K$	$\bar{\nu}_O$	$\bar{\nu}_1$	$\bar{\nu}_2$
150	0.2169	0.5198	0.08072
200	0.2524	0.4537	0.09393
250	0.2849	0.4095	0.1060
300	0.3155	0.3780	0.1174
350	0.3450	0.3543	0.1284
400	0.3739	0.3360	0.1391
450	0.4026	0.3216	0.1498
500	0.4312	0.3100	0.1605
550	0.4600	0.3006	0.1712
600	0.4892	0.2930	0.1821
650	0.5187	0.2868	0.1930
700	0.5488	0.2818	0.2042
750	0.5794	0.2777	0.2156
800	0.6107	0.2744	0.2273
850	0.6426	0.2717	0.2391
900	0.6752	0.2697	0.2513
950	0.7085	0.2681	0.2637
1000	0.7425	0.2669	0.2763
1100	0.8127	0.2655	0.3024
1200	0.8857	0.2653	0.3296
1300	0.9615	0.2658	0.3578
1400	1.040	0.2670	0.3870
1500	1.1214	0.2687	0.4173
1600	1.2054	0.2708	0.4484
1700	1.2918	0.2731	0.4807
1800	1.3807	0.2757	0.5138
1900	1.4718	0.2784	0.5477
2000	1.5652	0.2813	0.5824
2500	2.0585	0.2960	0.7661
3000	2.5829	0.3095	0.9612
3500	3.1220	0.3206	1.162
4000	3.6633	0.3292	1.363
4500	4.1986	0.3353	1.562
5000	4.7239	0.3396	1.758
5500	5.2364	0.3422	1.949
6000	5.7359	0.3436	2.134
6500	6.2208	0.3440	2.315

TABLE VIII (Contd)

$T, {}^{o}K$	$\bar{\nu}_o$	$\bar{\nu}_1$	$\bar{\nu}_2$
7000	6.6927	0.3436	2.491
7500	7.1522	0.3428	2.662
8000	7.5997	0.3414	2.828
8500	8.0345	0.3397	2.990
9000	8.4580	0.3378	3.147
9500	8.8735	0.3357	3.302
10000	9.2755	0.3334	3.452

N_O - number of oxygen atoms per cm^3.

TABLE VIIIA

AVERAGE ELECTRON COLLISION FREQUENCY FOR WEAKLY IONIZED ARGON

$(\omega >> \nu)$

$$\bar{\nu} = \bar{\nu}_o \cdot 10^{11} \frac{\rho}{\rho_o} = \bar{\nu}_1 \cdot 10^8 P_{mm\,Hg} \quad , \quad sec^{-1}$$

$T, {}^oK$	$\bar{\nu}_o$	$\bar{\nu}_1$
100	0.8358	3.004
200	0.6869	1.234
300	0.5469	0.6552
400	0.4410	0.3962
500	0.3657	0.2629
600	0.3130	0.1875
700	0.2767	0.1410
800	0.2527	0.1135
900	0.2381	0.0951
1000	0.2311	0.0831
1500	0.2791	0.0669
2000	0.4234	0.0761
2500	0.6350	0.0913
3000	0.8974	0.1075
3500	1.201	0.1234
4000	1.541	0.1385
4500	1.914	0.1529
5000	2.317	0.1665
6000	3.207	0.1921
7000	4.199	0.2156
8000	5.284	0.2374
9000	6.452	0.2577
10000	7.693	0.2765
11000	9.000	0.2941
12000	10.36	0.3104
13000	11.78	0.3256
14000	13.23	0.3396
15000	14.72	0.3526
16000	16.23	0.3645
17000	17.76	0.3754
18000	19.29	0.3852
19000	20.83	0.3941
20000	22.37	0.4020

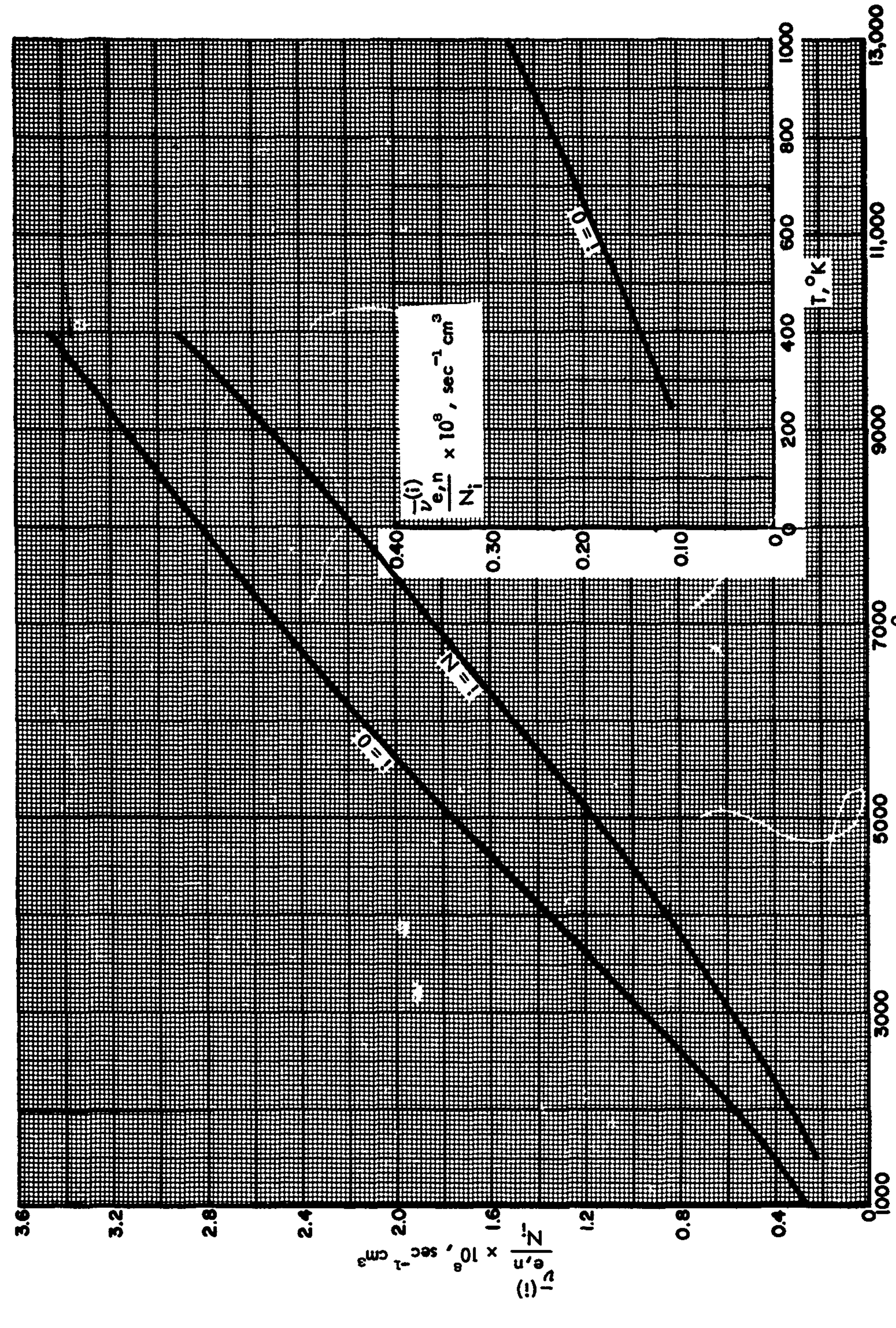

FIGURE 8 Average Electron Collison Frequency for Atomic Oxygen and Atomic Nitrogen ($\omega >> \nu$)

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TABLE IX

AVERAGE ELECTRON COLLISION FREQUENCY FOR WEAKLY IONIZED DRY AIR (MODEL I)

($\omega >> \nu$)

78.0881% N_2, 20.9795% O_2 and 0.9324% A, $\rho_0 = 1.223 \times 10^{-3}$ gm/cm^3

$$\bar{\nu}_{e,n}(\text{air}),\ \text{sec}^{-1} = \bar{\nu}_0 \cdot 10^{11} \frac{\rho}{\rho_0} = \bar{\nu}_1 \cdot 10^{8}\, P_{mm\,Hg}$$

T, °K	ν_0	ν_1
200	1.200	2.157
210	1.259	2.154
220	1.317	2.152
230	1.375	2.149
240	1.433	2.146
250	1.491	2.144
260	1.549	2.141
270	1.606	2.138
280	1.663	2.135
290	1.720	2.132
300	1.777	2.129
310	1.833	2.125
320	1.889	2.122
330	1.945	2.118
340	2.000	2.114
350	2.055	2.110
360	2.110	2.106
370	2.164	2.102
380	2.218	2.098
390	2.272	2.094
400	2.325	2.089
500	2.842	2.043
600	3.329	1.994
700	3.791	1.947
800	4.231	1.901
900	4.651	1.857
1000	5.054	1.816
1200	5.814	1.741
1400	6.526	1.675
1600	7.200	1.617
1800	7.847	1.567
2000	8.474	1.523

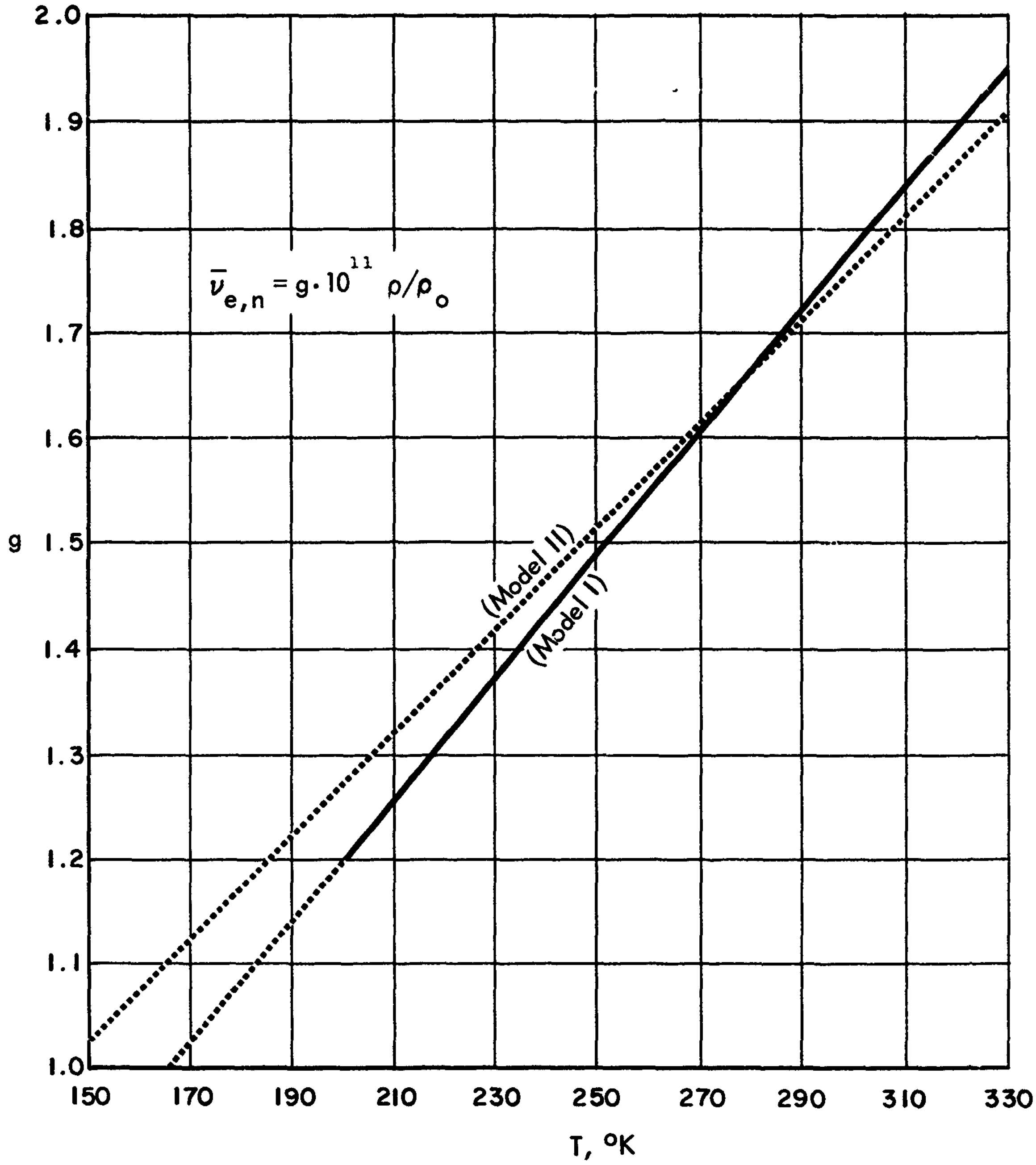

FIGURE 9 Average Collision Frequency for Weakly Ionized Dry Low Temperature Air (Model II)

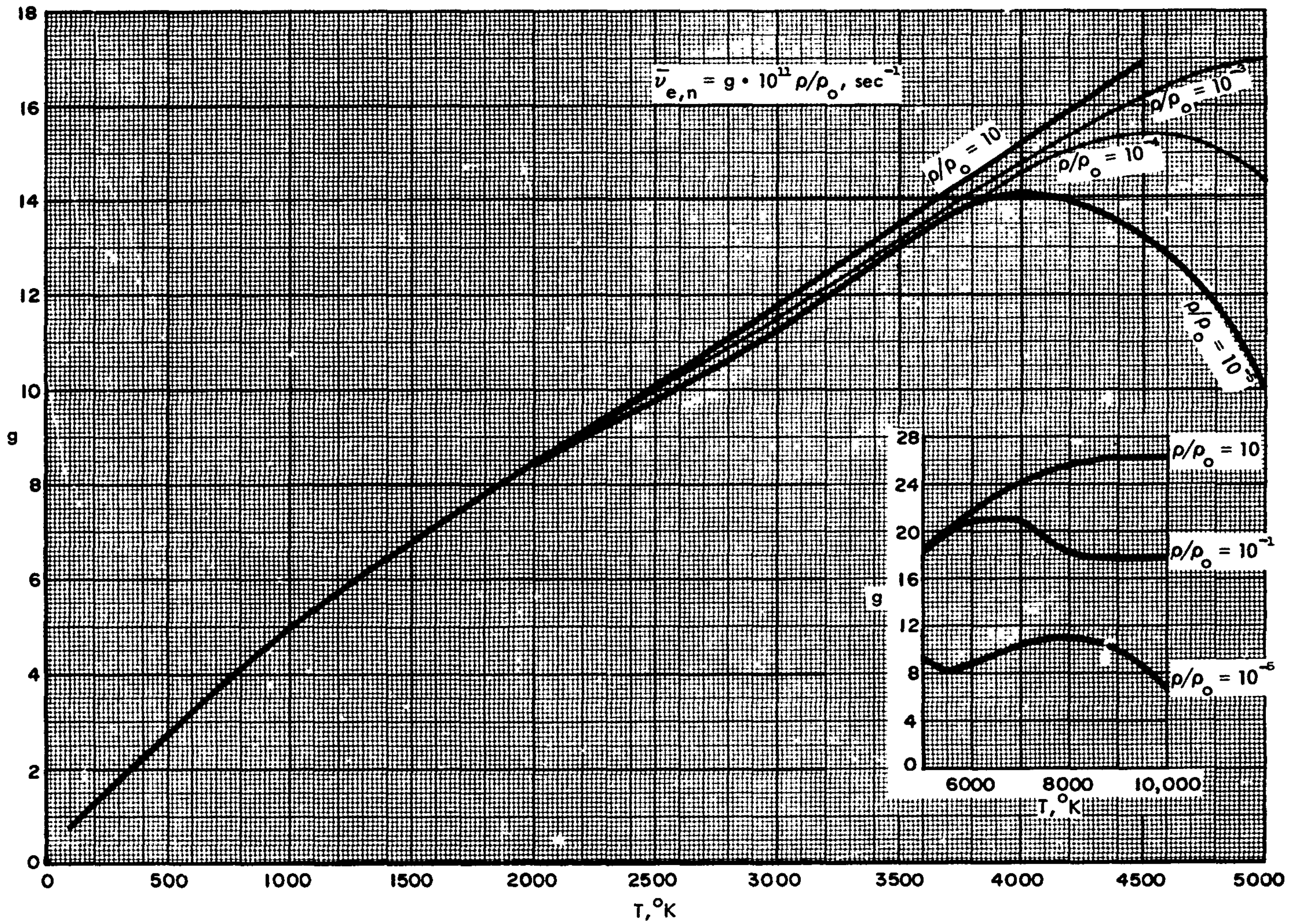

FIGURE 10 Average Electron-Neutral Collision Frequency in Equilibrium Air ($\omega >> \nu$)

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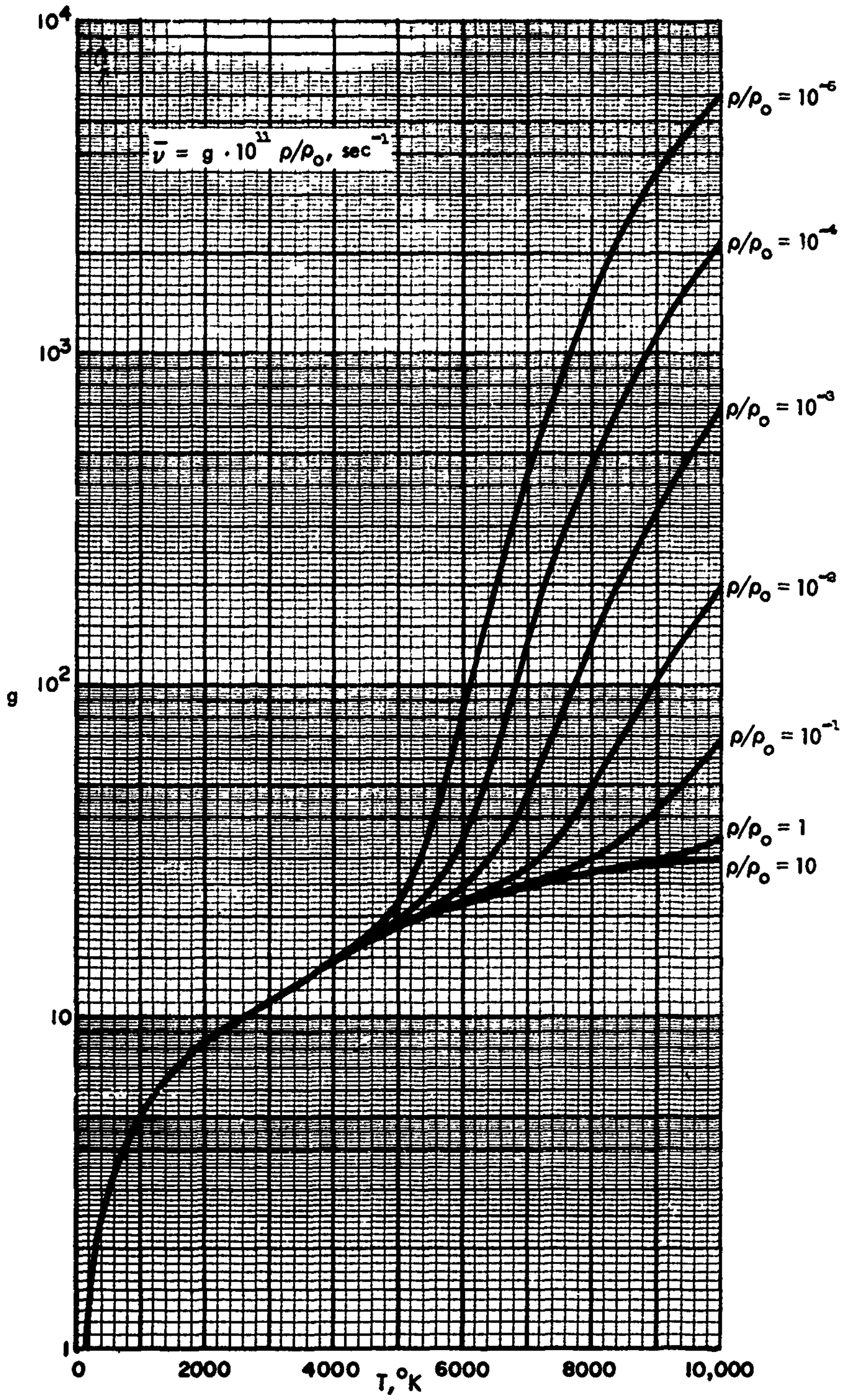

FIGURE 11 Total Average Electron Collison Frequency of Equilibrium Air ($\omega >> \nu$)
(Electron-Neutral + Electron-Ion)

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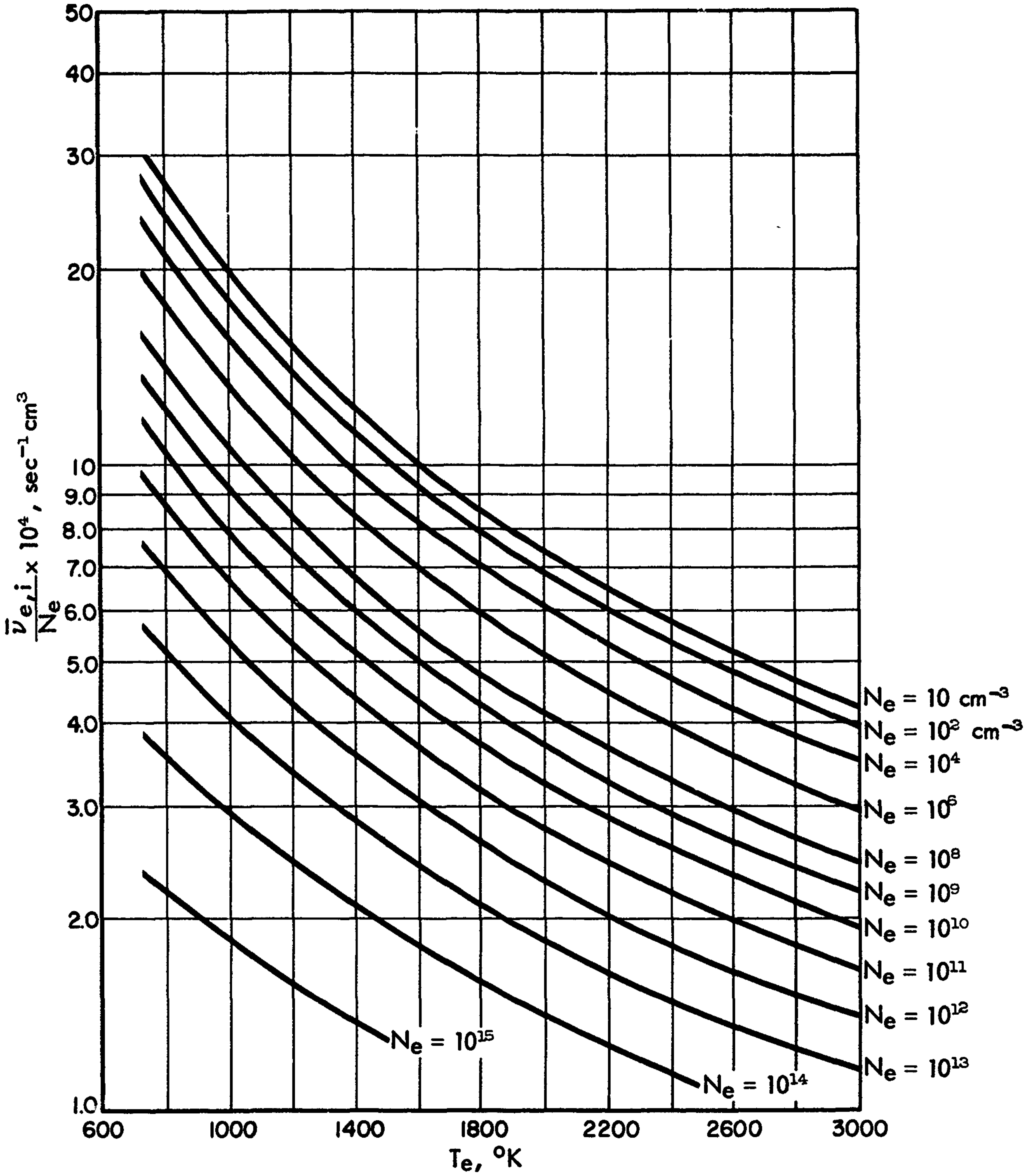

FIGURE 12 Average Electron Ion Collision Frequency ($\omega >> \nu$)
(Basedon Coulomb scattering with Debye cut-off)

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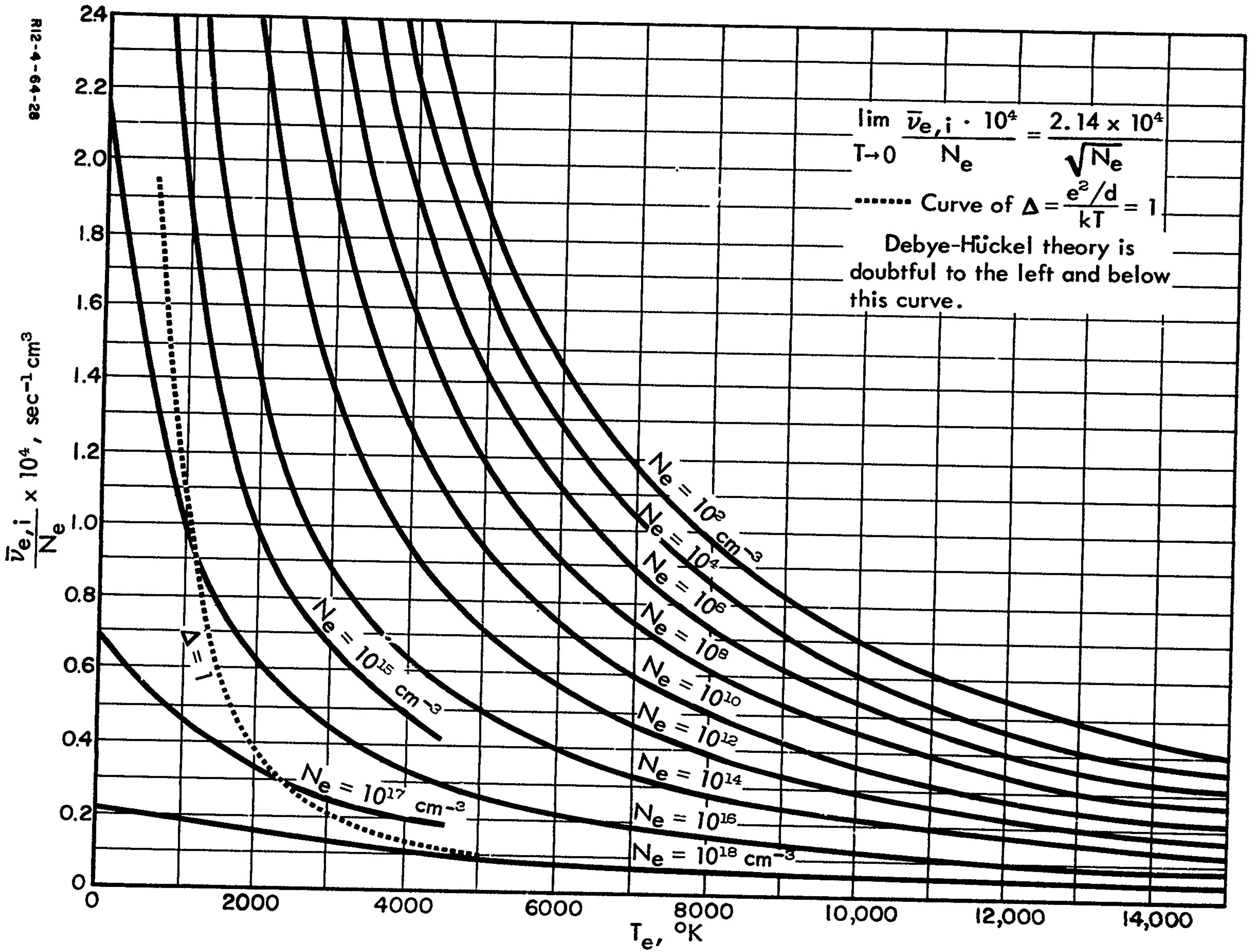


FIGURE 13 Average Electron Ion Collision Frequency ($\omega >> \nu$) (Based on Coulomb scattering with Debye cut-off)

TABLE X

AVERAGE ELECTRON COLLISION FREQUENCY FOR
HIGH TEMPERATURE EQUILIBRIUM AIR*

$(\omega \gg \nu, \quad \bar{\nu} = \bar{\nu}_{e,n} + \bar{\nu}_{e,i})$

T, °K	$\log_{10}\rho/\rho_0$	$\bar{\nu}_{e,n}$, sec^{-1}	$\bar{\nu}$, sec^{-1}	$10^{-11}\cdot\bar{\nu}/\frac{\rho}{\rho_0}$
2000	-5	8.459×10^{6}	8.459×10^{6}	8.459
	-4	8.484×10^{7}	8.484×10^{7}	8.484
	-3	8.492×10^{8}	8.492×10^{8}	8.492
	-2	8.495×10^{9}	8.495×10^{9}	8.495
	-1	8.495×10^{10}	8.495×10^{10}	8.495
2500	-5	9.746×10^{6}	9.750×10^{6}	9.750
	-4	9.924×10^{7}	9.925×10^{7}	9.925
	-3	10.03×10^{8}	10.04×10^{8}	10.04
	-2	1.008×10^{10}	1.008×10^{10}	10.08
	-1	1.009×10^{11}	1.009×10^{11}	10.09
	0	1.010×10^{12}	1.010×10^{12}	10.10
	1	1.010×10^{13}	1.010×10^{13}	10.10
3000	-5	1.127×10^{7}	1.132×10^{7}	11.32
	-4	1.133×10^{8}	1.136×10^{8}	11.36
	-3	1.148×10^{9}	1.150×10^{9}	11.50
	-2	1.165×10^{10}	1.165×10^{10}	11.65
	-1	1.173×10^{11}	1.173×10^{11}	11.73
	0	1.176×10^{12}	1.176×10^{12}	11.76
	1	1.177×10^{13}	1.177×10^{13}	11.77
3500	-5	1.291×10^{7}	1.326×10^{7}	13.26
	-4	1.299×10^{8}	1.317×10^{8}	13.17
	-3	1.307×10^{9}	1.316×10^{9}	13.16
	-2	1.322×10^{10}	1.326×10^{10}	13.26
	-1	1.340×10^{11}	1.341×10^{11}	13.41
	0	1.349×10^{12}	1.349×10^{12}	13.49
	1	1.352×10^{13}	1.352×10^{13}	13.52
4000	-5	1.405×10^{7}	1.546×10^{7}	15.46
	-4	1.457×10^{8}	1.530×10^{8}	15.30
	-3	1.477×10^{9}	1.513×10^{9}	15.13
	-2	1.490×10^{10}	1.507×10^{10}	15.07
	-1	1.508×10^{11}	1.515×10^{11}	15.15
	0	1.523×10^{12}	1.526×10^{12}	15.26
	1	1.531×10^{13}	1.531×10^{13}	15.31

* Based on species concentration from Refs. 34 and 35.

TABLE X (Contd)

$T, {}^{\circ}K$	$\log_{10}\rho/\rho_o$	$\bar{\nu}_{e\ n}$, sec^{-1}	$\bar{\nu}$, sec^{-1}	$10^{-11} \cdot \bar{\nu}/\frac{\rho}{\rho_o}$
4500	-5	$1.320x10^{7}$	$1.720x10^{7}$	17.20
	-4	$1.541x10^{8}$	$1.752x10^{8}$	17.52
	-3	$1.626x10^{9}$	$1.733x10^{9}$	17.33
	-2	$1.658x10^{10}$	$1.710x10^{10}$	17.10
	-1	$1.678x10^{11}$	$1.701x10^{11}$	17.01
	0	$1.696x10^{12}$	$1.705x10^{12}$	17.05
	1	$1.708x10^{13}$	$1.710x10^{13}$	17.10
5000	-5	$1.008x10^{7}$	$1.938x10^{7}$	19.38
	-4	$1.442x10^{8}$	$1.921x10^{8}$	19.21
	-3	$1.701x10^{9}$	$1.948x10^{9}$	19.48
	-2	$1.803x10^{10}$	$1.924x10^{10}$	19.24
	-1	$1.843x10^{11}$	$1.898x10^{11}$	18.98
	0	$1.865x10^{12}$	$1.887x10^{12}$	18.87
	1	$1.879x10^{13}$	$1.885x10^{13}$	18.85
5500	-5	$0.851x10^{7}$	$3.423x10^{7}$	34.23
	-4	$1.173x10^{8}$	$2.159x10^{8}$	21.59
	-3	$1.631x10^{9}$	$2.113x10^{9}$	21.13
	-2	$1.886x10^{10}$	$2.124x10^{10}$	21.24
	-1	$1.985x10^{11}$	$2.095x10^{11}$	20.95
	0	$2.023x10^{12}$	$2.069x10^{12}$	20.69
	1	$2.041x10^{13}$	$2.055x10^{13}$	20.55
6000	-5	$0.8809x10^{7}$	$8.300x10^{7}$	83.00
	-4	$9.988x10^{8}$	$3.293x10^{8}$	32.93
	-3	$1.422x10^{9}$	$2.301x10^{9}$	23.01
	-2	$1.868x10^{10}$	$2.282x10^{10}$	22.82
	-1	$2.083x10^{11}$	$2.277x10^{11}$	22.77
	0	$2.163x10^{12}$	$2.245x10^{12}$	22.45
	1	$2.191x10^{13}$	$2.217x10^{13}$	22.17
7000	-5	$1.032x10^{7}$	$4.238x10^{8}$	423.8
	-4	$1.056x10^{8}$	$1.308x10^{9}$	130.8
	-3	$1.153x10^{9}$	$4.657x10^{9}$	46.57
	-2	$1.558x10^{10}$	$2.694x10^{10}$	26.84
	-1	$2.075x10^{11}$	$2.540x10^{11}$	25.40
	0	$2.345x10^{12}$	$2.542x10^{12}$	25.42
	1	$2.439x10^{13}$	$2.509x10^{13}$	25.09
8000	-5	$1.126x10^{7}$	$1.451x10^{9}$	1451.
	-4	$1.203x10^{8}$	$4.356x10^{9}$	435.6
	-3	$1.242x10^{9}$	$1.333x10^{10}$	133.3
	-2	$1.370x10^{10}$	$4.780x10^{10}$	47.80
	-1	$1.835x10^{11}$	$2.871x10^{11}$	28.71
	0	$2.350x10^{12}$	$2.732x10^{12}$	27.32
	1	$2.592x10^{13}$	$2.730x10^{13}$	27.30

TABLE X (Contd)

$T, ^{\circ}K$	$\log_{10} \rho/\rho_0$	$\bar{\nu}_{e,n}$, sec^{-1}	$\bar{\nu}$, sec^{-1}	$10^{-11} \cdot \bar{\nu}/\frac{\rho}{\rho_0}$
9000	-5	1.030×10^{7}	3.465×10^{9}	3465.
	-4	1.285×10^{8}	1.097×10^{10}	1097.
	-3	1.381×10^{9}	3.269×10^{10}	326.9
	-2	1.441×10^{10}	1.015×10^{11}	101.5
	-1	1.658×10^{11}	4.040×10^{11}	40.40
	0	2.207×10^{12}	2.911×10^{12}	29.11
	1	2.639×10^{13}	2.873×10^{13}	28.73
10000	-5	6.871×10^{6}	5.872×10^{9}	5872.
	-4	1.218×10^{8}	2.164×10^{10}	2164.
	-3	1.472×10^{9}	6.658×10^{10}	665.8
	-2	1.570×10^{10}	1.981×10^{11}	198.1
	-1	1.672×10^{11}	6.577×10^{11}	65.77
	0	2.048×10^{12}	3.348×10^{12}	33.48
	1	2.594×10^{13}	2.966×10^{13}	29.65

VI. DESCRIPTION AND USE OF TABLE XVIII OF AVERAGE ELECTRON COLLISION FREQUENCY FOR WEAKLY IONIZED GASES (MAXWELLIAN VELOCITY DISTRIBUTION)

For a given i-th neutral species if its electron-neutral (momentum transfer) elastic cross section dependence on energy (or velocity) can be approximated by $Q_{e,n}^{(i)}$

$$Q_{e,n}^{(i)} = q_{\ell}^{(i)} E_{ev}^{\ \ell} = q_n^{(i)} v^{n-1} \cancel{\text{cm/sec}} \ , \tag{53}$$

where $q_{\ell}^{(i)}$ and $q_n^{(i)}$ are constants, then one can use Table XVIII, where for convenience for various n (and ℓ) and various temperatures, the following quantities are listed: $Y_{\ell}^{(i)}$, $D_{\ell}^{(i)}$, S_n and $R_{\ell}^{(i)}$, which are defined by the average (in the sense of Eq. (20)) collision frequency of an electron with i-th neutral species (to be used for $\omega \gg \nu$, or for any ω with α_1, α_2 and α_3, see Table XVII).

$$\bar{\nu}_{e,n}^{(i)}(\text{sec}^{-1}) = Y_{\ell}^{(i)} q_{\ell}^{(i)} C_i \frac{\rho}{\rho_o} = D_{\ell}^{(i)} q_{\ell}^{(i)} N_i(\text{cm}^{-3}) =$$

$$S_n C_i q_n^{(i)} \frac{\rho}{\rho_o} = R_{\ell}^{(i)} q_{\ell}^{(i)} P_{\text{mmHg}}^{(i)} \ ; \ \bar{\nu}_{e,n} = \sum_i \bar{\nu}_{e,n}^{(i)} \ , \tag{54}$$

where

$$n = 2\ell + 1 \ ,$$

$P^{(i)}_{mmHg}$ is the (ideal) gas partial pressure in mmHg, N_i is the number density of i-th neutral species per cm^3, ρ is the mass density of a given gas and ρ_o is ρ at $P_o = 1$ atm and $T_o = 273.16^oK$, C_i for an[35] ideal mixture is the number of i-th particles at a given high temperature and pressure (or density) divided by the total number of particles at P_o and T_o. If the gas is ideal, nondissociated and nonionized $C_i = X_i$ is the fraction of the i-th particle in the mixture, $\sum_i X_i = 1$. For ideal diatomic gas at T_o and P_o, which is completely dissociated at some T and P, $\sum C_i = 2$. Similarly, for completely ionized ideal gas, which at T_o and P_o is monatomic, $\sum C_i = 2$, and for the same gas consisting of only doubly ionized atoms and electrons (e.g., A^{++} and e), $\sum C_i = 3$, etc. (The inclusion of real gas corrections, i.e., long distance Coulomb and virial corrections[35] will modify C_i's.) We have

$$N_i = C_i \frac{\rho}{\rho_o} L_o \quad ; \quad \frac{P^{(i)}}{P_o} = C_i \frac{\rho}{\rho_o} \frac{T}{T_o} \quad , \quad P = \sum P^{(i)} , \qquad (55)$$

where P is the total gas pressure.

If T_1 is any listed temperature in Table XVIII, then for any other T

$$\bar{\nu}^{(i)}_{e,n}(T) = \left(\frac{T}{T_1}\right)^{\ell+\frac{1}{2}} C_i q^{(i)}_{\ell} Y_{\ell}(T_1) \frac{\rho}{\rho_o} = \left(\frac{T}{T_1}\right)^{\ell-\frac{1}{2}} q^{(i)}_{\ell} R_{\ell}(T_1) P^{(i)}_{mmhg} \qquad (56)$$

The total average electron-neutral collision frequency is

$$\bar{\nu}_{e,n}(T) = \sum_i \bar{\nu}^{(i)}_{e,n} \qquad (57)$$

For one component gas with complicated velocity (energy) dependence of cross-sections we can fit a polynominal to electron-neutral cross-section (given in E_{ev} or in $v_{cm/sec}$ as in Eq.(53)).

Then reading directly from Table XVIII, $D_\ell = D_\ell(T)$ we have

$$\bar{\nu}_{e,n} = N \sum_\ell q_\ell D_\ell(T). \tag{58}$$

There is no direct way of finding α's without additional numerical integration.

For the general case of multicomponent mixture we can fit for the i-th species a polynominal to its cross-section, i.e.,

$$Q_{e,n}^{(i)}(cm^2) = \sum_\ell q_\ell^{(i)} E_{ev}^{\ \ell} = \sum_n q_n^{(i)} v^{n-1} \tag{59}$$

and reading directly D_ℓ from Table 6

$$\bar{\nu}_{e,n}^{(i)} = N_i \sum_\ell q_\ell^{(i)} D_\ell \tag{60}$$

with final total average electron collision frequency summed over all neutral constituents,

$$\bar{\nu}_{e,n} = \sum_i \bar{\nu}_{e,n}^{(i)} . \tag{61}$$

The listed quantities in Table XVIII were computed from (for Maxwellian distribution)

$$\left.\begin{aligned} Y_\ell &= \frac{4}{3\sqrt{\pi}} \sqrt{\frac{2kT_e}{m_e}} \left(\frac{T_e}{11605}\right)^\ell L_o \Gamma(\ell+3) \\ S_n &= \left(\frac{2k \cdot 11605}{m_e}\right)^\ell Y_\ell = \frac{4}{3\sqrt{\pi}} L_o \left(\frac{2kT_e}{m_e}\right)^{n/2} \Gamma\left(\frac{n+5}{2}\right) \end{aligned}\right\} \tag{62}$$

$$R_\ell = \frac{273.16}{760} \frac{Y_\ell}{T_e} \quad ; \quad D_\ell = \frac{Y_\ell}{L_o} \quad ,$$

where $L_o = 2.6872 \times 10^{19} cm^{-3}$, and where 1 ev = 11605°K, i.e., if T is in °K and E in electron volts

$$\frac{1}{2}\frac{m_e v^2}{kT_e} = W = \frac{11605}{T_e} E_{ev} \ . \qquad (63)$$

<u>Example</u>

The momentum transfer elastic cross-section for electron with helium was measured [33] to be

$$Q = 5.3 \times 10^{-16} cm^2 \qquad \text{for} \qquad 0 \lesssim E \le 0.06 \text{ ev} \ .$$

Assuming this to be valid for higher energies we obtain an average electron-neutral collision frequency ($\omega >> \nu$) for weakly ionized pure helium at T = 300°K and any pressure.

We have for $\ell = 0$ at T = 300°K from Table XVIII $R_o = 4.62 \times 10^{23}$. Thus,

$$\bar{\nu}_{e,n} = 4.62 \times 10^{23} \cdot 5.3 \times 10^{-16} P_{mmHg} = 2.5 \times 10^{8} P_{mmHg}, \ sec^{-1} .$$

Experimental values for helium for P > 5mmHg was found to be[33]

$$\bar{\nu} \sim 3.12 \times 10^{8} P_{mmHg}, \ sec^{-1}.$$

VII. AVERAGE ELECTRON COLLISION FREQUENCY IN TERRESTIAL ATMOSPHERE

($\omega \gg \nu$ and $\omega \ll \nu$)

The largest error in a calculation of the electron collision frequency for an upper atmosphere as a function of an altitude is associated with the choice of the pressure for a given altitude and the uncertainty of a composition and electron temperature at high altitudes (e.g., see Fig. 14a and $\nu = \nu(h)$ in Benson[27]).

In Table XIII we indicate, as an example, a calculation for a particular model. Figure 14 indicates comparisons with calculations by Budden.[29] The atmosphere composition was taken from Refs. 30, 31 and 32. The electron ion collision frequency used in Eqs. 13 and 14 was that given by[1]

$$\nu_{ei}(v) = \frac{4\pi}{v^3}\left(\frac{e^2}{m_e}\right)^2 N_e \ln\left(1 + \frac{m_e v^2}{e^2}\lambda_d\right)$$

where λ_d is the Debye length,

$$\lambda_d = \sqrt{\frac{kT}{8\pi N_e e^2}} \simeq 4.88\sqrt{\frac{T}{N_e}}\ , \text{cm} \quad (T_e = T_i)\ . \qquad (64)$$

For $\omega \gg \nu$

$$\bar{\nu} = \bar{\nu}_{e,n} + \bar{\nu}_{e,i}\quad ,$$

where

$$\bar{\nu}_{e,i} \simeq 3.633\,\frac{N_e}{T_e\sqrt{T_e}}\ln\left(1 + \frac{3279\ T_e\sqrt{T_i}}{\sqrt{N_e}}\eta\right)\quad , \qquad (65)$$

where T_e and T_i are electron and ion temperatures, respectively, N_e is the electron concentration per cm^3 and where

$$\eta = \sqrt{\frac{2T_e}{T_e + T_i}} \quad . \qquad (66)$$

In equilibrium, $T = T_e = T_i$ and $\eta = 1$. The expression for $\bar{\nu}_{e,i}$ holds for $kT_e < e^2/d$, i.e., for $T_e > 5 \times 10^{-3} N_e^{1/3}$.

In Fig. 12 and Fig. 13, the electron ion collision frequency was computed from exponential integral.[1]

In Fig. 14a is given a particular interpretation of the electron temperature from a dumbbell probe which is still questionable.[40]

TABLE XIII

AVERAGE ELECTRON COLLISION FREQUENCY
FOR AN ATMOSPHERIC MODEL

($\omega \gg \nu$)

h, km	T, °K	$\bar{\nu}_{e,n}$, sec^{-1}	$\bar{\nu}_{e,i}$, sec^{-1}	$\bar{\nu}$, sec^{-1}: $\bar{\nu} = \bar{\nu}_{e,n} + \bar{\nu}_{e,i}$	$\bar{\nu}$, sec^{-1}
0	288	1.71×10^{11}	--	1.71×10^{11}	
10	217	4.21×10^{10}	--	4.21×10^{10}	
20	217	9.27×10^{9}	--	9.27×10^{9}	
30	232	2.03×10^{9}	--	2.03×10^{9}	
40	241	4.57×10^{8}	--	4.57×10^{8}	
50	283	1.44×10^{8}	--	1.44×10^{8}	
60	256	4.25×10^{7}	--	4.25×10^{7}	
70	212	6.72×10^{6}	--	6.72×10^{6}	
80	197	2.32×10^{6}	--	2.32×10^{6}	
90	197	3.11×10^{5}	--	3.11×10^{5}	3.39×10^{5}
100	300	6.73×10^{4}	--	6.73×10^{4}	6.50×10^{4}
110	390	1.71×10^{4}	--	1.71×10^{4}	1.51×10^{4}
120	480	5.08×10^{3}	--	5.08×10^{3}	8.20×10^{3}
130	570	1.81×10^{3}	--	1.81×10^{3}	2.10×10^{3}
140	660	7.79×10^{2}	--	7.81×10^{2}	11.0×10^{2}
160	840	2.30×10^{2}	--	2.32×10^{2}	
190	1100	7.53×10^{1}	2.2	7.75×10^{1}	
220	1200	2.76×10^{1}	11.4	3.90×10^{1}	
250	1200	1.20×10^{1}	5.82×10^{1}	7.02×10^{1}	
300	1200	3.74	2.10×10^{2}	2.14×10^{2}	
350	1200	1.35	4.29×10^{2}	4.30×10^{2}	
400	1200	5.40×10^{-1}	6.33×10^{2}	6.34×10^{2}	
500	1200	9.92×10^{-2}	3.15×10^{2}	3.15×10^{2}	
550	1200	4.54×10^{-2}	2.21×10^{2}	2.21×10^{2}	
600	1200	2.14×10^{-2}	1.57×10^{2}	1.57×10^{2}	
650	1200	1.02×10^{-2}	1.11×10^{2}	1.11×10^{2}	
700	1200	4.98×10^{-3}	7.82×10^{1}	7.82×10^{1}	
750	1200	2.45×10^{-3}	5.48×10^{1}	5.48×10^{1}	

Based on:

$0 \le h \le 90$ km, constant composition, ICAS Standard Atmosphere, from Handbook of Chemistry and Physics, 43d ed., pg. 3422 (1961-1962).

$100 \le h \le 750$ km, from L.R. Megil and N.P. Carleton, J. Geophys. Res. 69, 101 (1964). Assumption $T_e = T_g \equiv T$.

Last column: $\bar{\nu}$ based on atmosphere model by Nicolet,[31] with $T_e = T_g$ and his T_g (see Fig. 14).

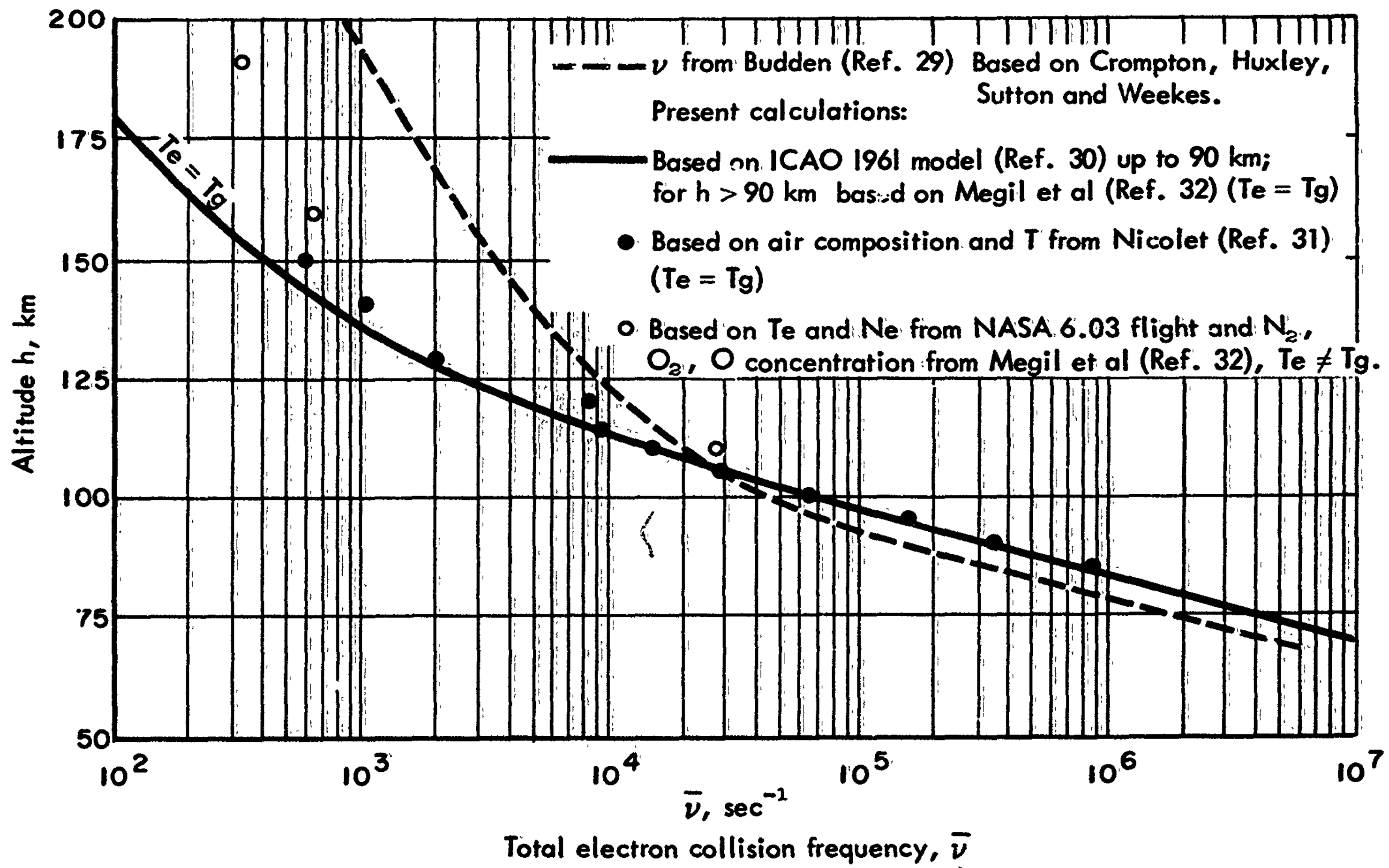


FIGURE 14 The Dependence of the Total Average Electron Collision Frequency $\bar{\nu}$ ($\omega >> \nu$) in Earth Atmosphere

R12-4-64-12

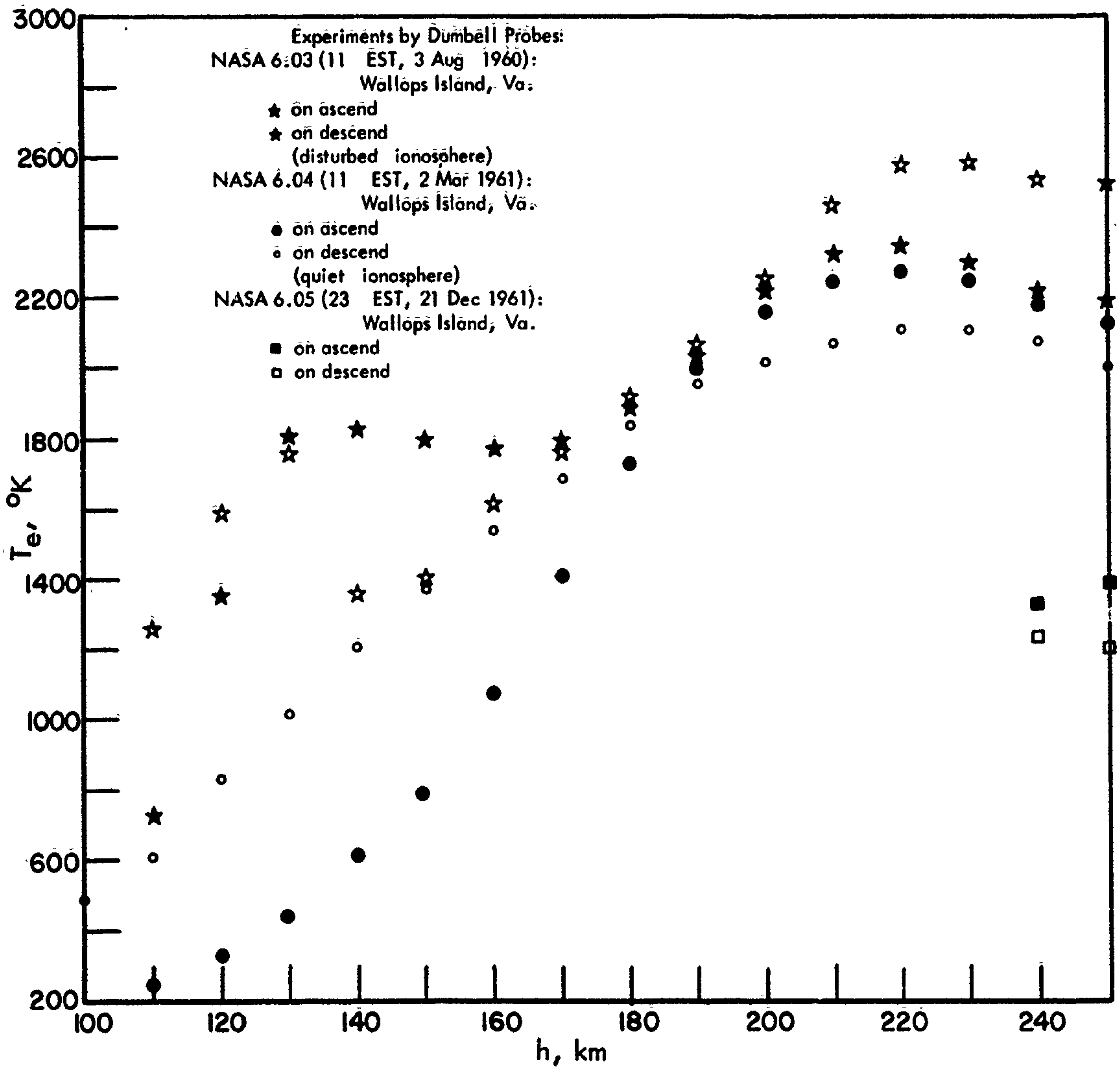


FIGURE 14a Measured Electron Temperature, T_e vs. Altitude

RI2-4-64-29

From Brace, L.H., et al., J. Geophys. Res. 68, 5397 (1963)

VIII. THE ELECTRIC CONDUCTIVITY OF WEAKLY IONIZED GASES FOR ANY MICROWAVE FREQUENCY

As defined in Eqs.(6)-(8), the corrections to the electric conductivity of weakly ionized plasma of N_2, O_2 and Air are given in Tables XI, XII, XIV, XV and XVI and in Figs. 15 - 23. For a gas having momentum transfer cross-section given by Eq. (53), Table XVII and Figs. 24 - 26 give corrections to the electric conductivity.

TABLE XI

THE DC ELECTRIC CONDUCTIVITY FOR DIATOMIC NITROGEN

$$\sigma_{DC} = \frac{\omega_p^2}{\nu_{DC}}$$

$$\nu_{DC} = \nu_{DC}^{o} \cdot 10^{11} \frac{\rho}{\rho_o} \text{ , sec}^{-1}$$

T, ^oK	ν_{DC}^{o}
250	1.014
300	1.209
350	1.405
400	1.600
500	1.986
600	2.365
700	2.736
800	3.099
1000	3.799
1200	4.465
1400	5.101
1600	5.710
1800	6.295
2000	6.860

TABLE XII

THE DC ELECTRIC CONDUCTIVITY OF O_2 AND AIR

(MODEL I)

$$\sigma' = \frac{\omega_p^2}{\nu_{DC}}$$

$$\nu_{DC} = \nu_{DC}^{0} \cdot 10^{11} \frac{\rho}{\rho_0} \; ; \; \nu_{DC} = \frac{\bar{\nu}}{\alpha_2(0)\alpha_3(0)} \; , \; \alpha_2(0) = \alpha_2 \text{ at } \omega = 0, \text{ etc.}$$

T, °K	ν_{DC}^{0} for O_2, (Model I)	ν_{DC}^{0} for Air, (Model I)
200	0.625	0.778
250	0.734	0.954
300	0.840	1.130
350	0.946	1.305
400	1.050	1.479
500	1.255	1.824
600	1.457	2.163
700	1.656	2.494
800	1.851	2.818
900	2.043	3.134
1000	2.232	3.444
1200	2.599	4.041
1400	2.952	4.610
1600	3.291	5.156
1800	3.616	5.681
2000	3.927	6.187

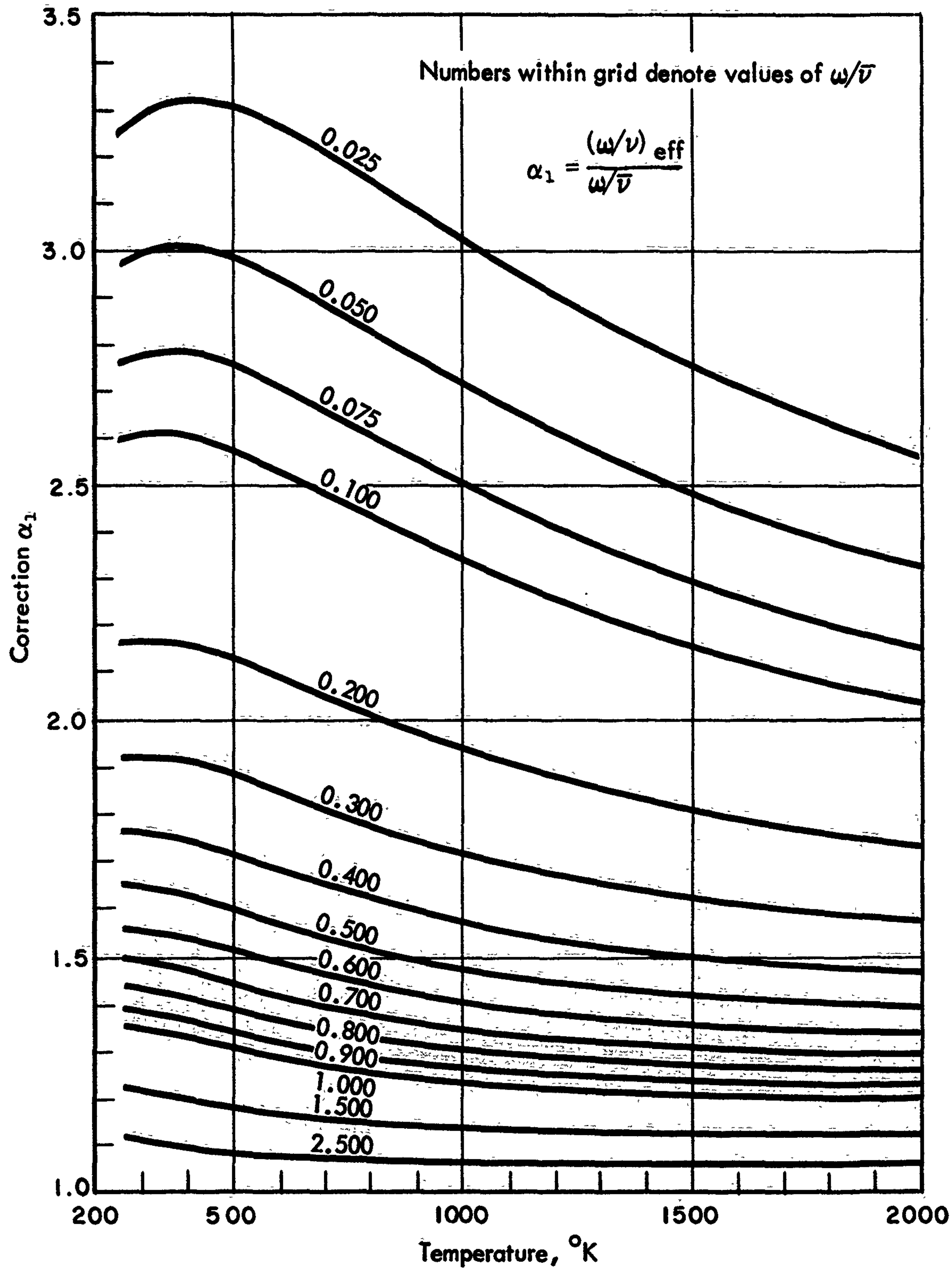


FIGURE 15 Correction α_1 for Weakly Ionized Nitrogen, N_2

R12-4-64-13

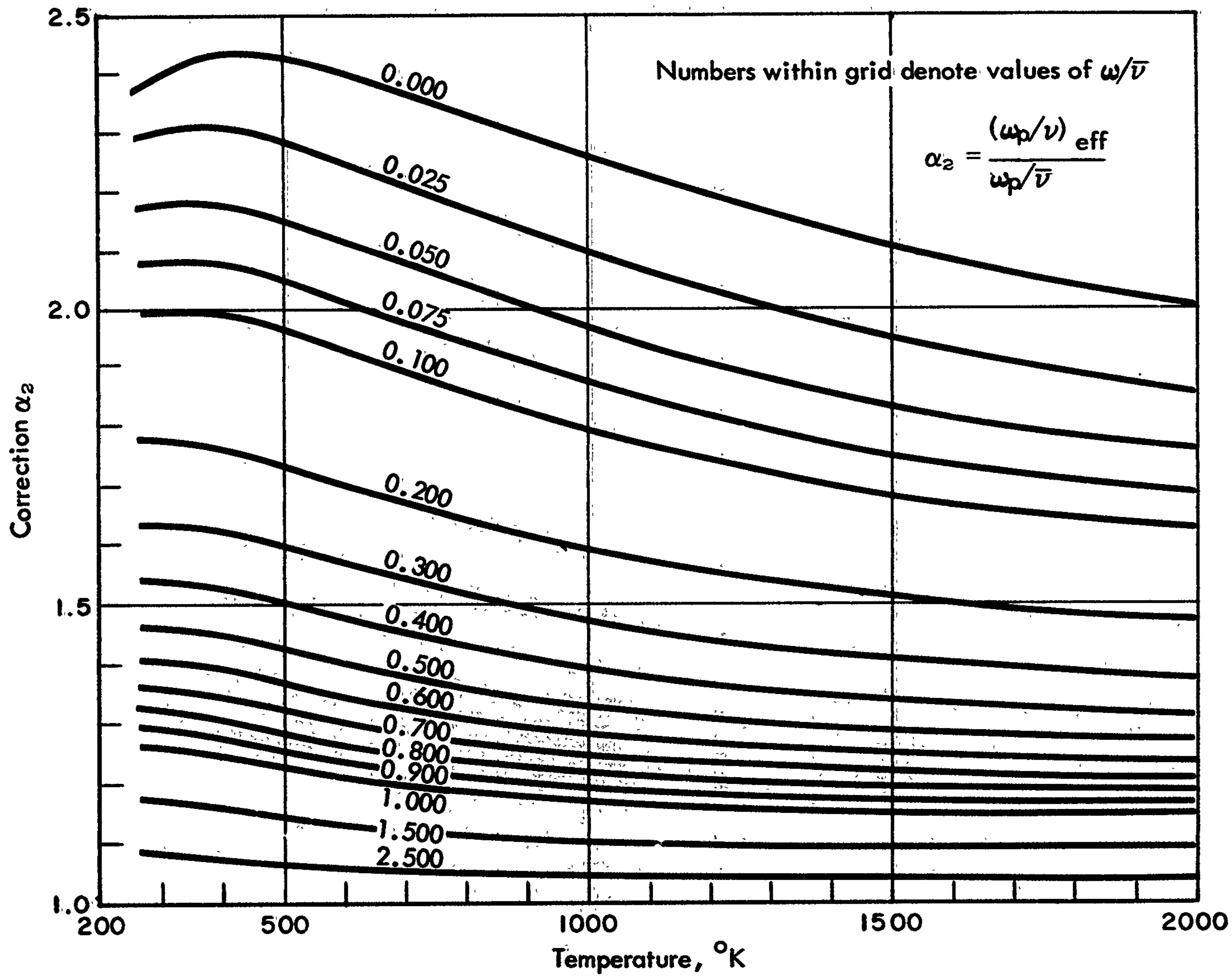


FIGURE 16 Correction α_2 for Weakly Ionized Nitrogen, N_2

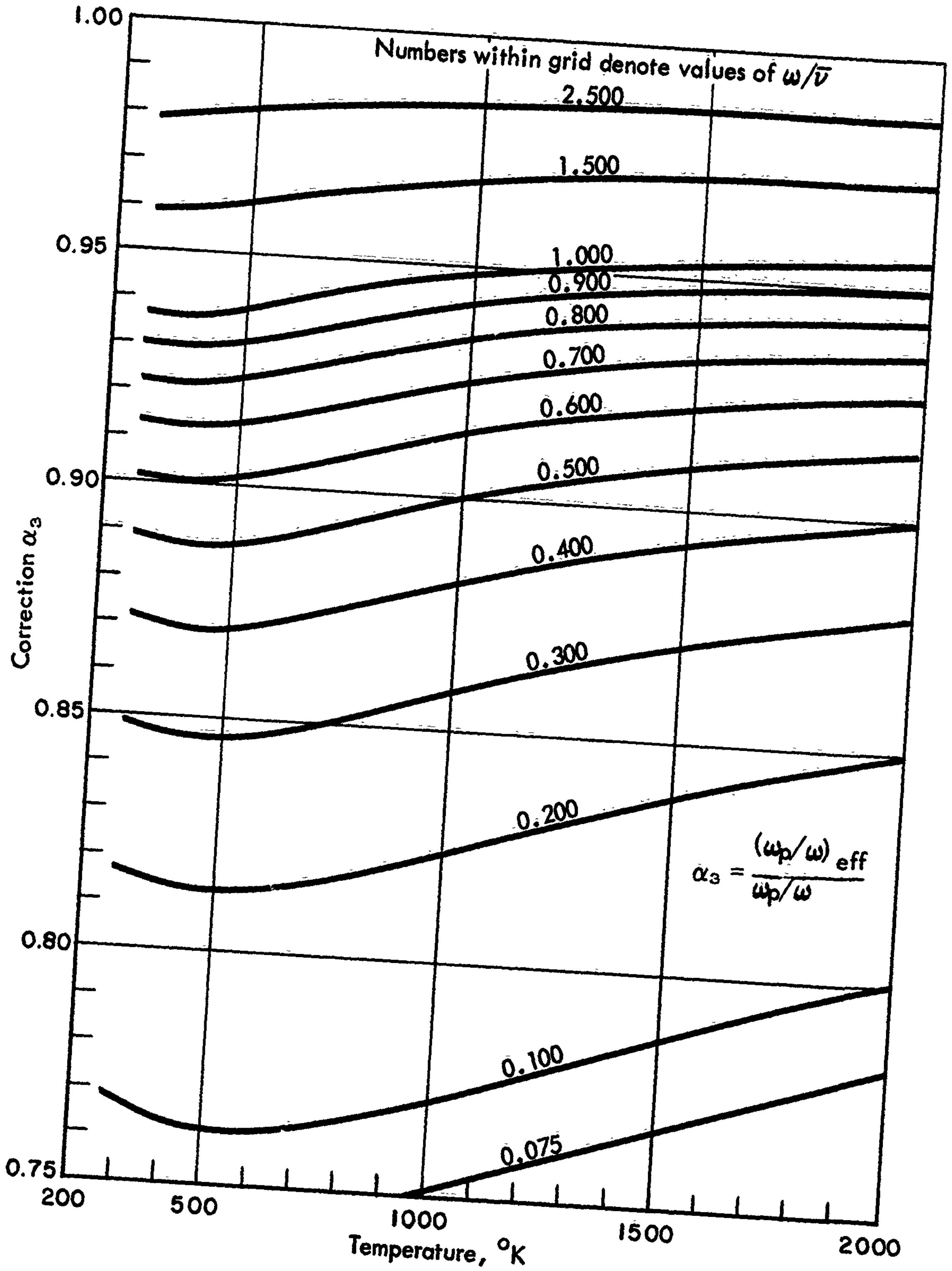


FIGURE 17 Correction α_3 for Weakly Ionized Nitrogen, N_2

R12-4-64-15

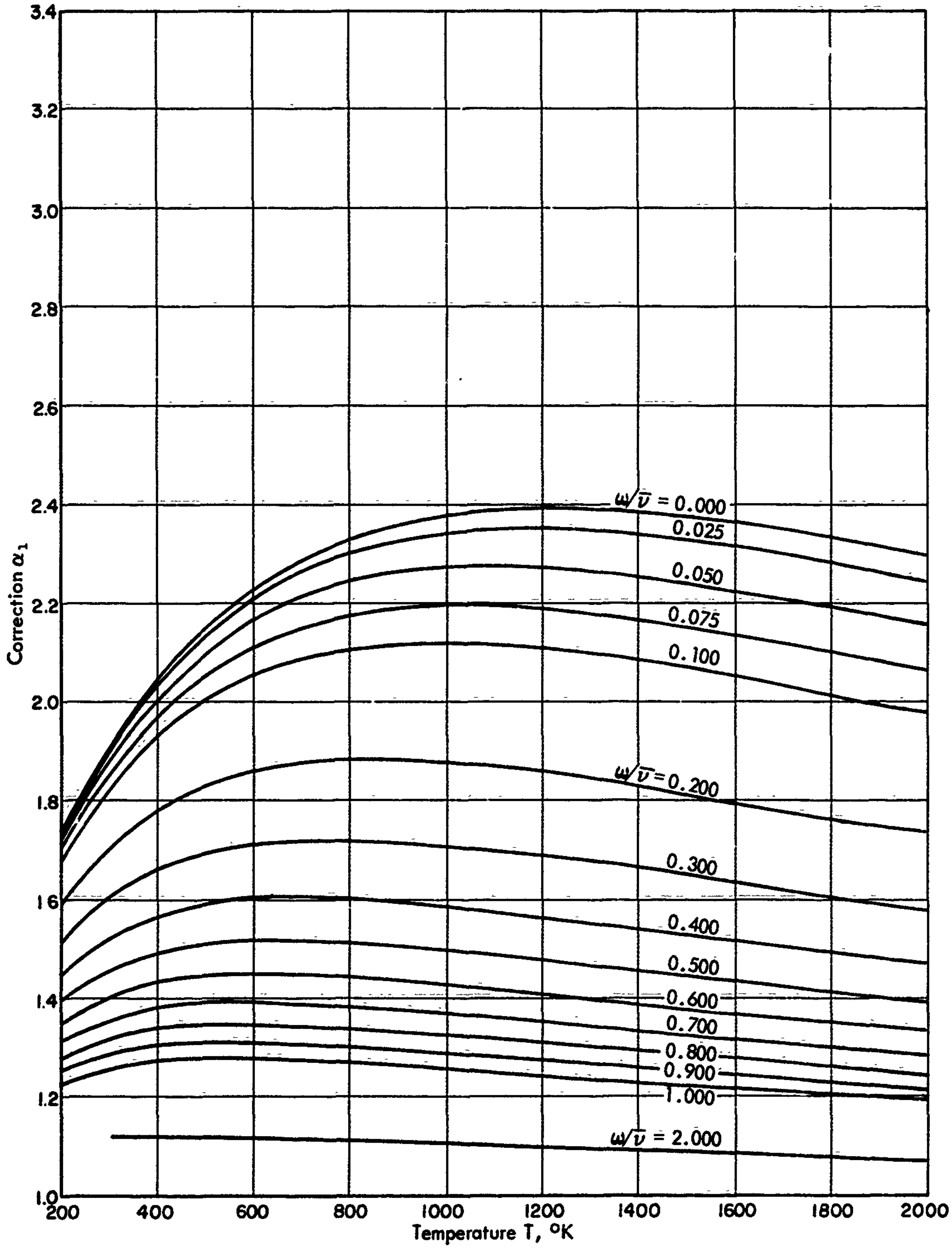


FIGURE 18 Correction α_1 for Weakly Ionized Oxygen, O_2, at Constant $\omega/\bar{\nu}$ (MODEL I)

R12-28-64-2

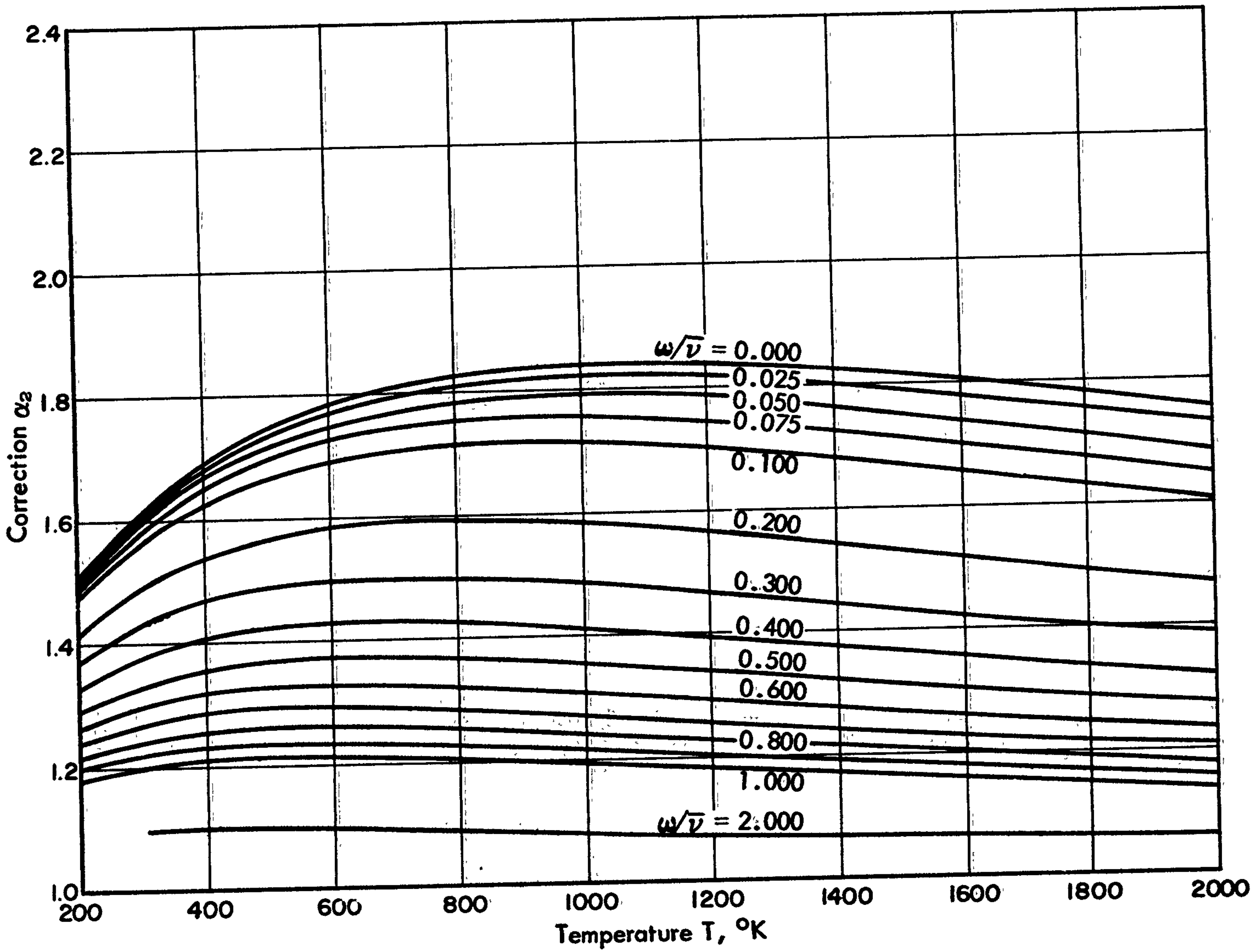
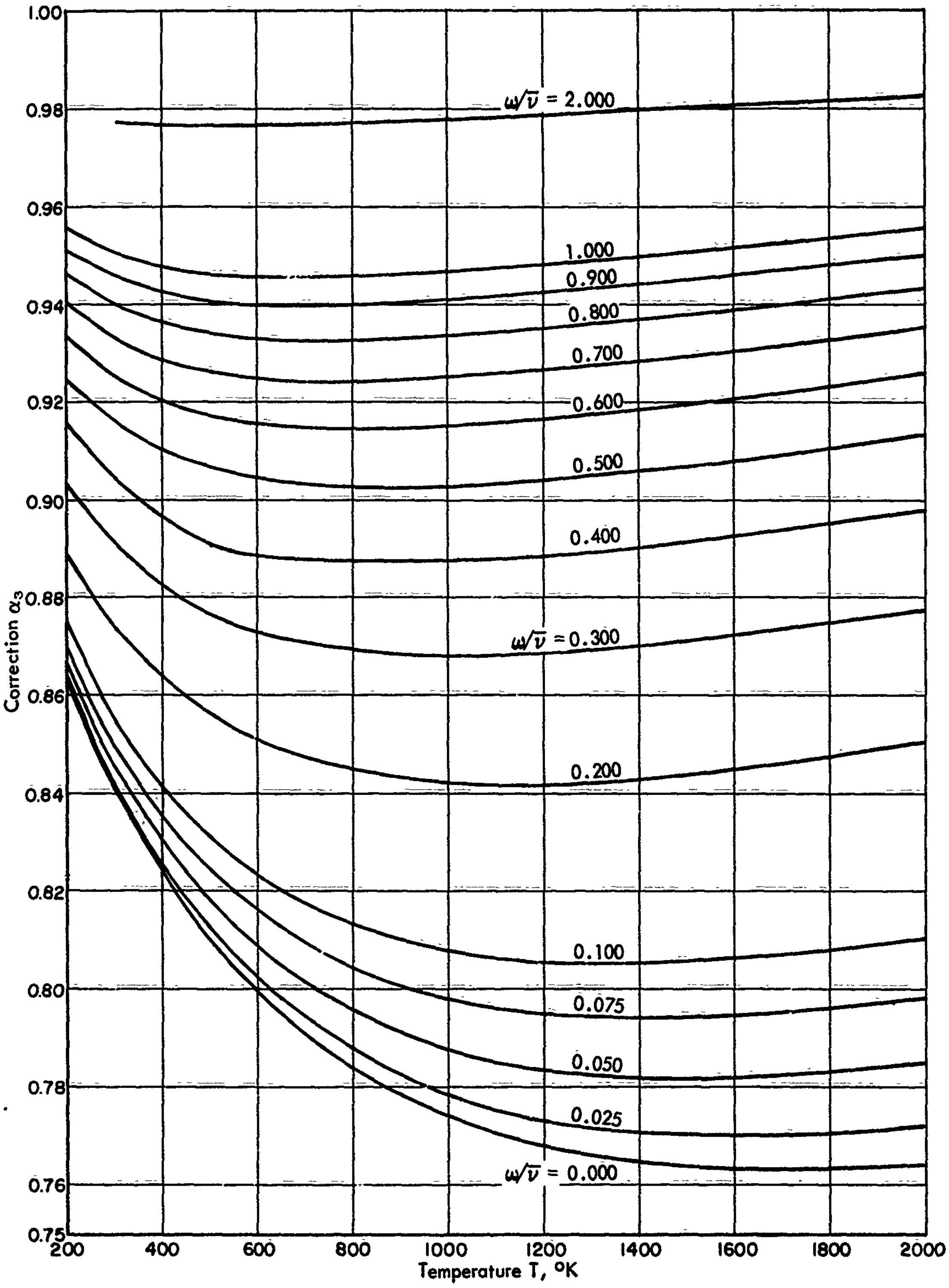


FIGURE 19 Correction α_2 for Weakly Ionized Oxygen, O_2, at Constant $\omega/\bar{\nu}$ (MODEL I)



R12-28-64-4

FIGURE 20 Correction α_3 for Weakly Ionized Oxygen, O_2, at Constant $\omega/\bar{\nu}$ (MODEL I)

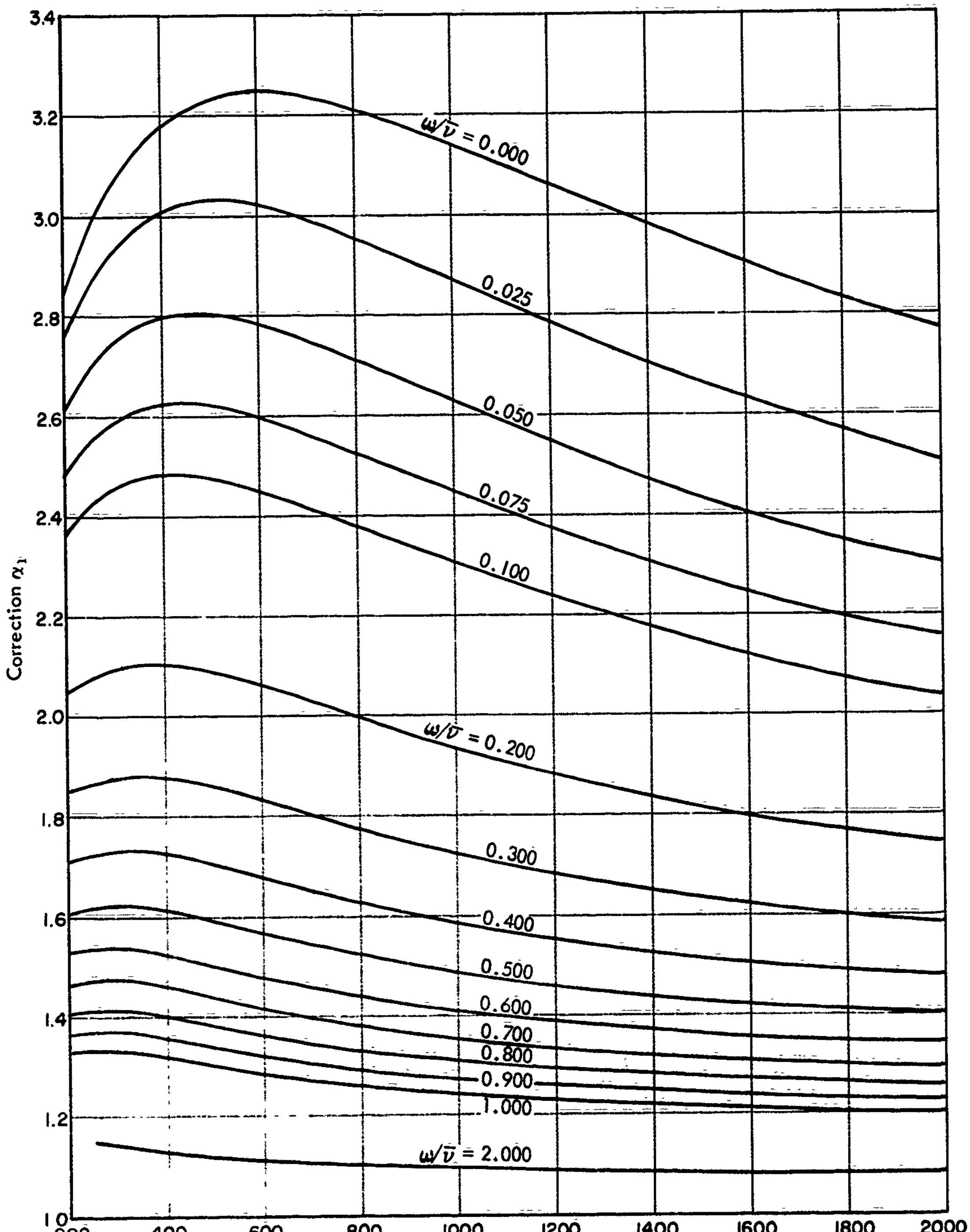


FIGURE 21 Correction α_1 for Weakly Ionized Air (Model I)

R12-28-64-5

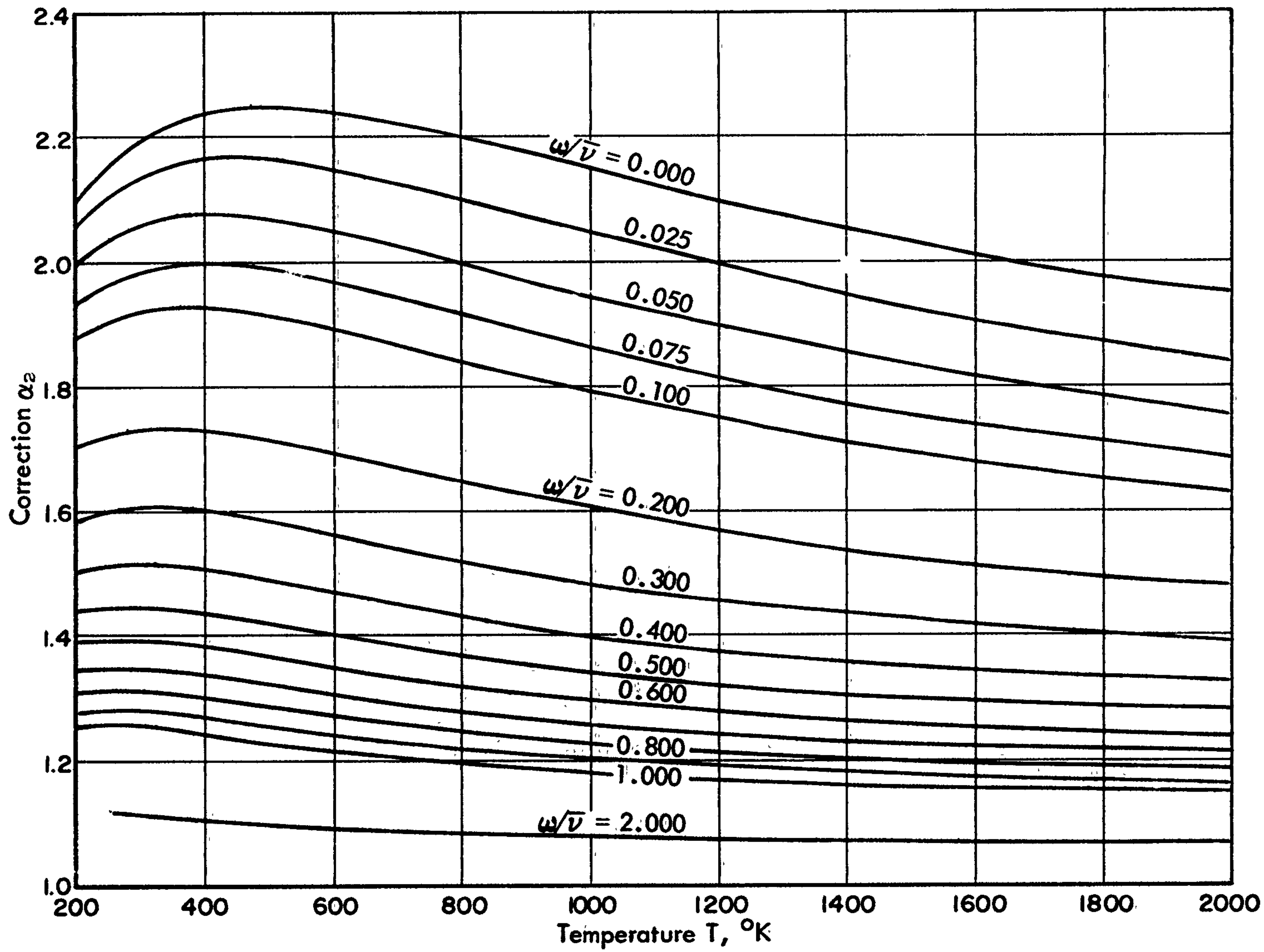


FIGURE 22 Correction α_2 for Weakly Ionized Air (Model I)

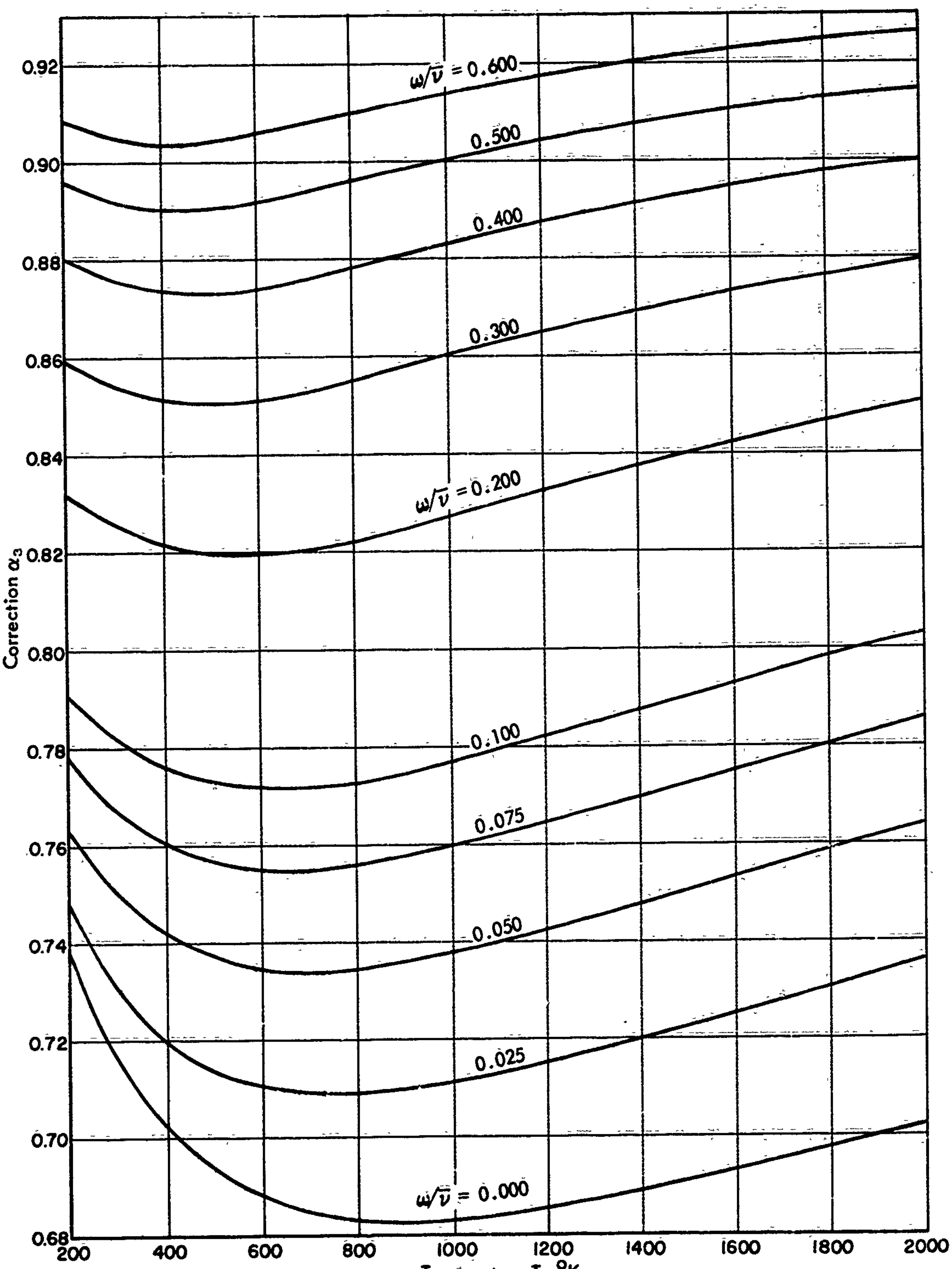


FIGURE 23 Correction α_3 for Weakly Ionized Air (Model I)

R12-28-64-7

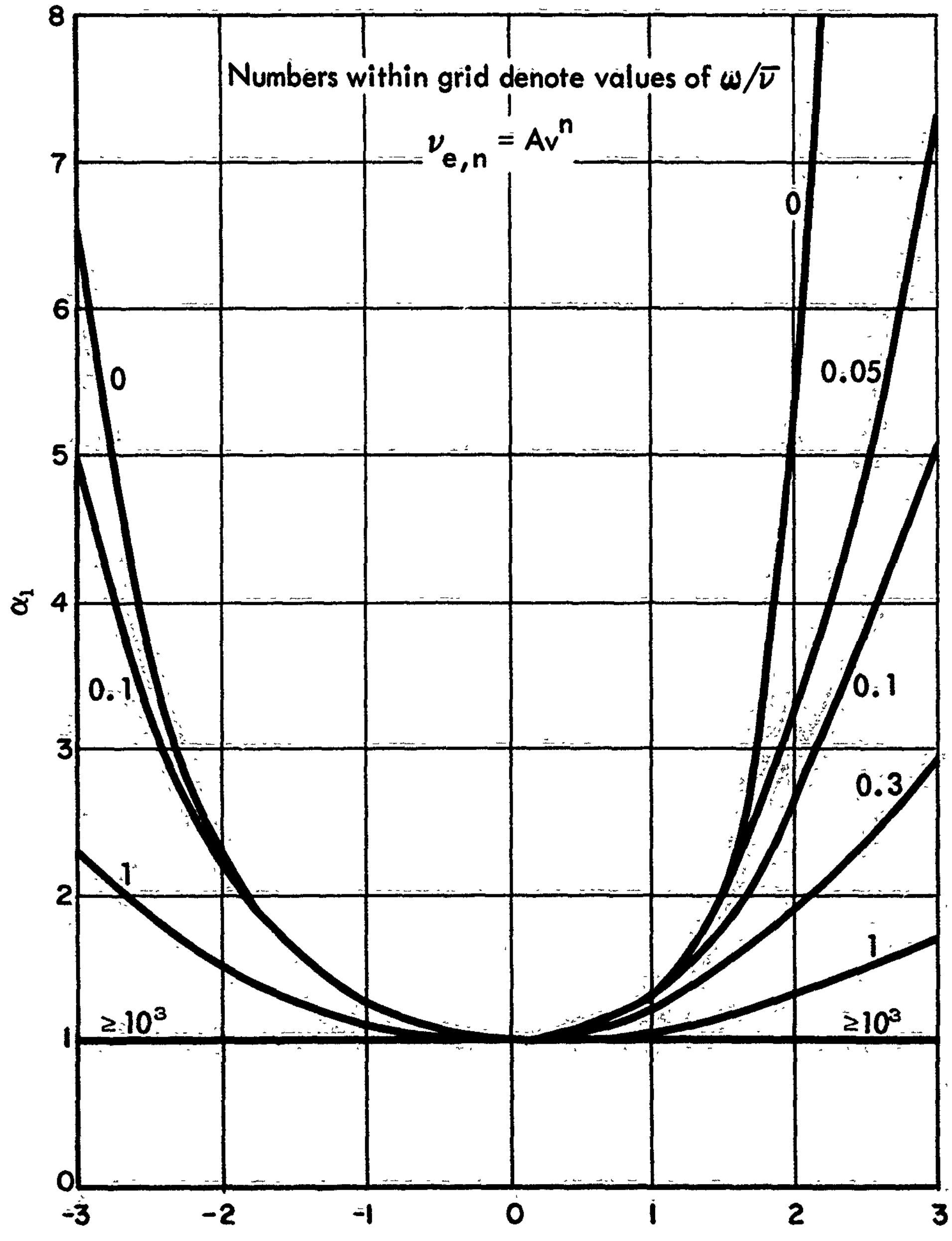


FIGURE 24 Correction α_1 for Weakly Ionized Plasma

R12-4-64-22

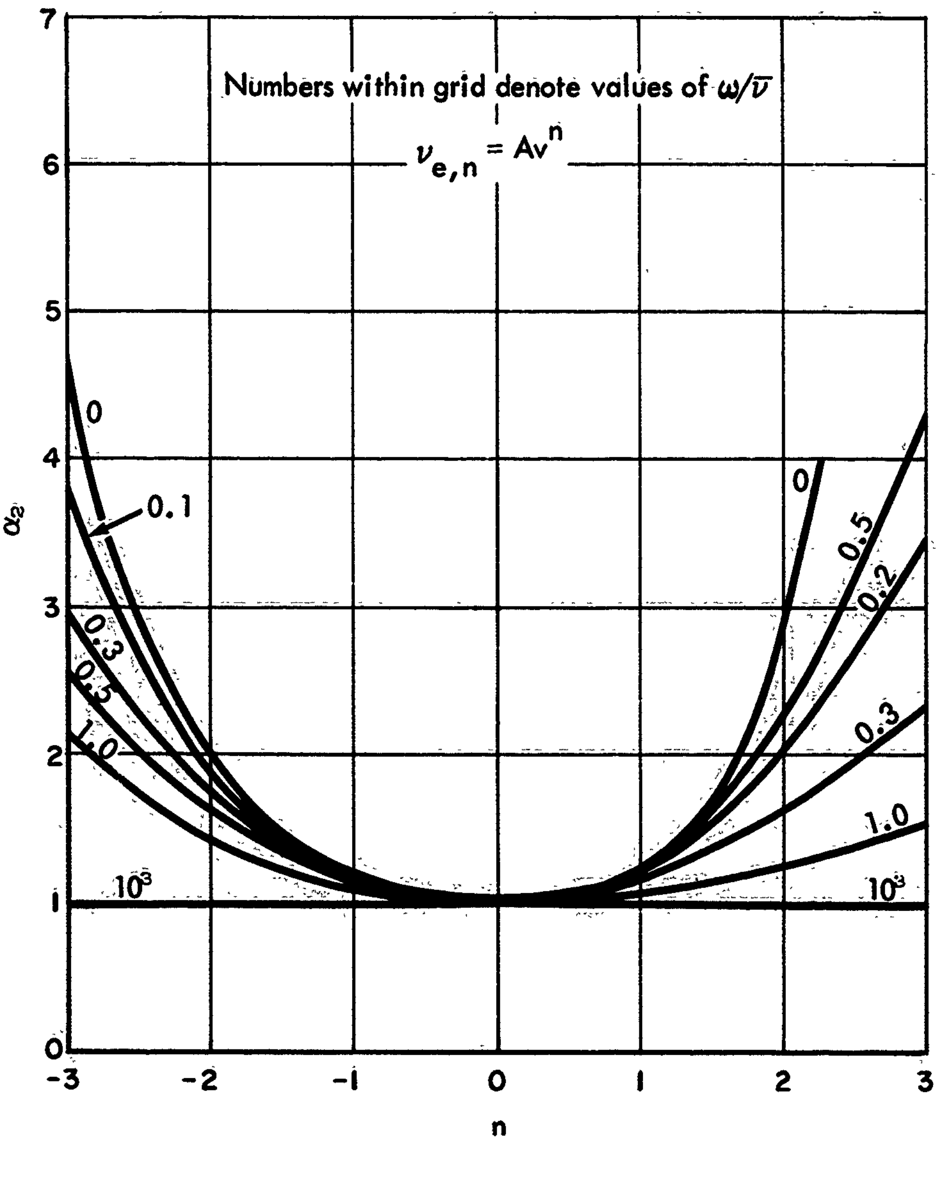


FIGURE 25 Correction α_2 for Weakly Ionized Plasma

R12-4-64-23

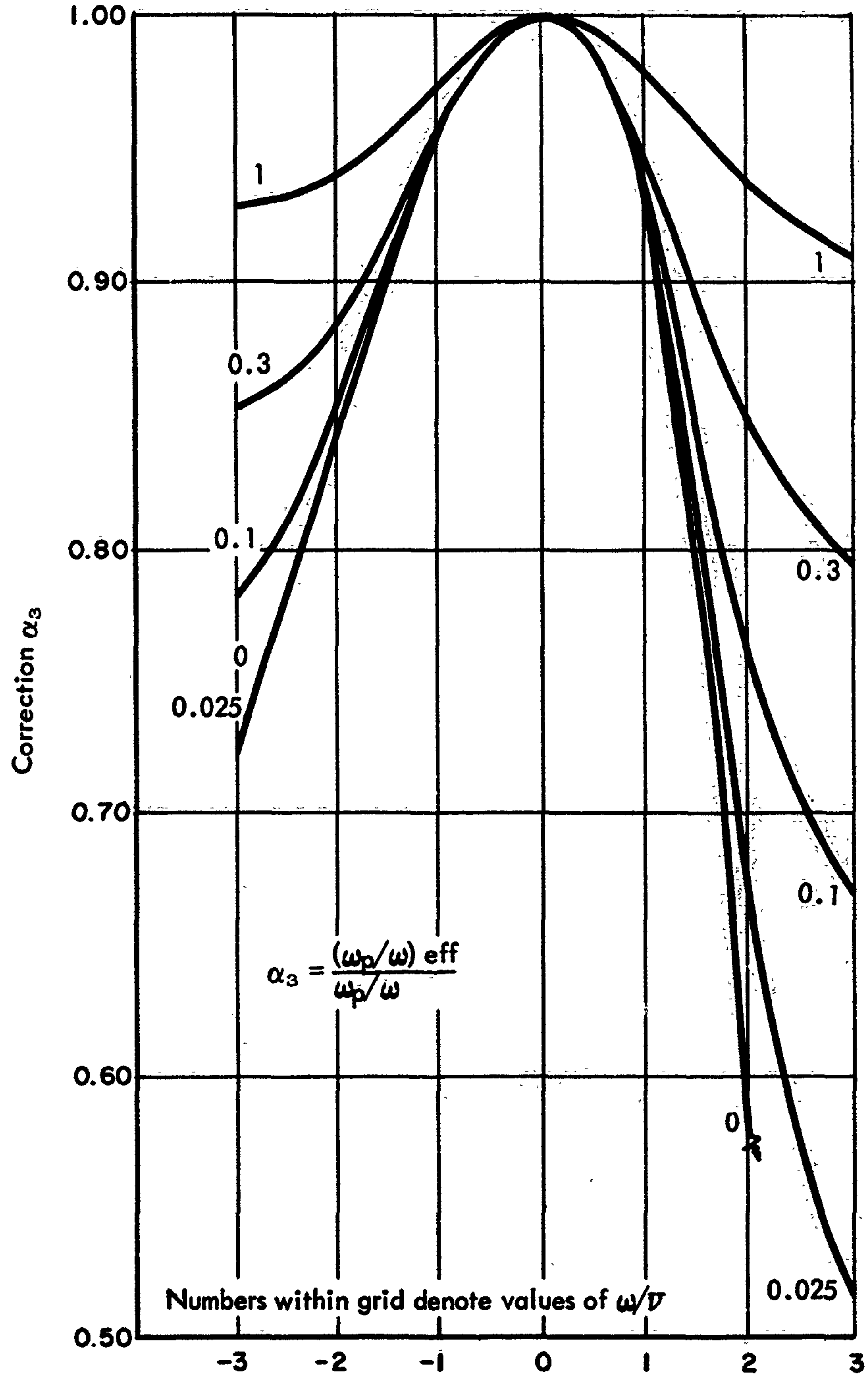


FIGURE 26 Correction α_3 for Weakly Ionized Plasma

R12-4-64-24

REFERENCES

1. Hochstim, A.R., Transport Processes and Microwave Propagation in Plasmas, (to be published by Academic Press)

2. Hochstim, A.R., "Effective Collision Frequencies and Electric Conductivities of Highly Ionized Air," Part II of this Report, (to be published shortly)

3. Majumder, R.C., Zs.f. Physik, 107, 599 (1937)

4. Margenau, H., Phys. Rev., 69, 508 (1946); 109, 6 (1958)

5. Allis, W.P., Handbuch der Physik, Vol. 21, pg 369, Springer Verlag, Berlin, 1956

6. Lorentz, H.A., The Theory of Electrons, 1909, Dover Publ., Inc. (1952), Note 57
Langevin, P., C.R. Acad. Eci., Paris, 146, 530 (1908)

7. Shkarofsky, I.P., Can. J. Phys. 39, 1619 (1961). Also in: Shkarofsky, I.P., "Values of the Transport Coefficients in a Plasma for Any Degree of Ionization Based on Maxwellian Distribution", RCA DAMP Report, April 1961, Moorestown, New Jersey (under Contract DA-36-034-ORD-3144RD, ARPA Order 51).

8. Landshoff, R., Phys. Rev. 76, 904 (1949)

9. Salzer, H.E. and Zucker, R., Bull. Am. Math. Soc., 55, 1004-1012 (1949); reprinted in Handbook of Mathematical Functions, ed. by M. Abramovitz and I.A. Stegun, U.S. Dept. of Commerce, NBS, Applied Math. Series, 55, 923 (1964)

10. Hochstim, A.R., "Review of Experimental Electron Neutral Cross Sections", Appendix in Ref. 1.

11. Shkarofsky, I.P., M.P. Bachynski and T.W. Johnson, Electromagnetic Effects of Re-entry, Pergamon Press, 1961. Also the same reprinted in Planetary Sciences 6, 24 (1961)

12. Phelps, A.V., "Studies and Experimental Work on Atomic Collision Processes Occurring in Atmospheric Gases," Rep. 63-928-113-R2, Dec. 31, 1963. Westinghouse Research Laboratory, Pittsburgh, Pa.

13. Pack, J.L. and A.V. Phelps, Phys. Rev. 121, 798 (1961)

14. Phelps, A.V., "Nonlinear Interaction Coefficient for Electrons in Nitrogen and Air," Paper 63-928-113-P6, Dec. 9, 1963. Westinghouse Research Laboratory, Pittsburgh, Pa.

15. Massey, H.S.W. and E.H.S. Burhop, Electronic and Ionic Phenomena, Oxford Univ. Press, 1956, pg. 206. (Data from Ramsauer Method.)

16. Engelhardt, A.G. and A.V. Phelps, Phys. Rev. 133, A375 (1964)

17. Neynaber, R.H., L.L. Marino, E.W. Rothe and S.M. Trujillo, Phys. Rev. 129, 2069 (1963)

18. Bauer, E.G. and H.N. Browne, Private communication in Ref. 17

19. Brüche, E., Ann d. Physik 83, 1065 (1927)

20. Lin, S.C. and B. Kivel, Phys. Rev. 114, 1026 (1959)

21. Normand, C.E., Phys. Rev. 35, 1217 (1930)

22. Bates, D.R. and H.S.W. Massey, Proc. Roy. Soc. (London) A192, 1 (1947)

23. Klein, M.M. and K.A. Brueckner, Phys. Rev. 111, 1115 (1958)

24. Neynaber, R.H. L.L. Marino, E.W. Rothe and S.M. Trujillo, Phys. Rev. 123, 148 (1961)

25. Bailey, V.A. and J.M. Sommerville, Phil. Mag. 17, 1169 (1934)

26. Engelhardt, A.G., A.V. Phelps and C.G. Risk, Phys. Rev. 135, A1566 (1964)

27. Benson, R.F., "The Cross Modulation of Cosmic Noise: A Technique for Investigating the Disturbed D Region." Scientific Report No. 1, May 1963. Geophysical Institute, University of Alaska, College, Alaska (UAG-R137). AFCRL-63-624, Fig. 3.1.

28. Lagow, H.E., R. Horowitz and J. Ainsworth, Results of IGY Atmospheric Density Measurements Above Fort Churchill, Space Research, Proceedings of the First Internation Space Science Symposium, Nice, Jan. 11-16, 1960. Edited by H. Kallmann, pp. 164-174

29. Budden, K.G., Radio Waves in the Ionosphere, Cambridge Press (1961)

30. Handbook of Chemistry and Physics, 43rd ed. 1961-1962, pg. 3422 (ICAO Stand. Atmosphere)

31. Nicolet, M., Dynamics of Manned Lifting Planetary Entry, ed. by Scalla, et al., J. Wiley, 1963, pg. 11

32. Megil, L.R. and N.P. Carlton, J. Geophys. Res. 69, 101 (1964)

33. Anderson, J.M. and L. Goldstein, Phys. Rev. 100, 1037 (1955)

34. Hochstim, A.R., "Equilibrium Composition, Thermodynamic and Normal Shock Properties of Air with Additives", Vol. 1, ZPh-122, Physics Section, General Dynamics, Convair, Dec. 1, 1961

35. Hochstim, A.R., "Theoretical Calculation of Thermodynamic Properties of Air" in Combustion and Propulsion, 5th AGARD COLLOQUIUM (NATO), Pergamon Press, Oxford, London, 1964

36. Phelps, A.V., Private communication, Dec. 9, 1964

37. Parthasarathy, R., G.M. Lerfald and C.G. Little, J. Geophys. Res. 68, 3581 (1963)

38. Serafimov, K. and G. Nestorov, Geomagnetism i Aeronomiya (in Russian), 3, 1059 (1963)

39. Belikovich, V.V., M.A. Itkin and L.V. Rodygin, Geomagnetism i Aeronomiya (in Russian), 4, 788 (1964)

40. Bettinger, R.T., "An in situ Probe System for the Measurement of Ionospheric Parameters", Univ. of Maryland, Dept. of Physics and Astronomy, Ph.D. Thesis, June 1964, V. I, 2.

Table XIV

Corrections to Weakly Ionized N_2

TABLE XIV

WEAKLY IONIZED N_2

$T = 250^{\circ}K$

$\bar{\nu}/\omega$	α_1	α_2	α_3	γ	η	S
.000	3.456	2.371	.6856	1.6254	1.6254	45.4221
.025	3.233	2.282	.7057	1.5997	1.6007	44.7050
.050	2.964	2.167	.7312	1.5504	1.5543	43.3281
.075	2.754	2.072	.7523	1.4949	1.5053	41.7753
.100	2.589	1.993	.7698	1.4379	1.4525	40.1640
.200	2.168	1.775	.8186	1.2231	1.2720	34.1809
.300	1.927	1.658	.8500	1.0434	1.1373	29.1589
.400	1.767	1.541	.8724	.8967	1.0402	25.0584
.500	1.651	1.469	.8894	.7767	.9708	21.7046
.600	1.564	1.412	.9028	.6778	.9218	18.9417
.700	1.495	1.366	.9137	.5957	.8876	16.6467
.800	1.439	1.328	.9227	.5269	.8641	14.7240
.900	1.393	1.296	.9303	.4688	.8485	13.1007
1.000	1.354	1.269	.9368	.4194	.8388	11.7198
1.500	1.227	1.176	.9587	.2571	.8356	7.1849
2.000	1.157	1.124	.9711	.1717	.8584	4.7979
2.500	1.115	1.091	.9788	.1218	.8852	3.4042
5.000	1.037	1.030	.9931	.0367	.9556	1.0249
10.000	1.010	1.008	.9981	.0098	.9865	.2729
25.000	1.002	1.001	.9997	.0016	.9977	.0445
100.000	1.000	1.000	1.0000	.0001	.9999	.0028

$\bar{\nu} = 1.648 \times 10^{11} \frac{\rho}{\rho_o} = 2.369 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 1.014 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 300^oK$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	S
.000	3.552	2.405	.6771	1.6285	1.6285	38.0702
.025	3.285	2.301	.7005	1.6011	1.6021	37.4290
.050	2.994	2.179	.7276	1.5505	1.5544	36.2462
.075	2.776	2.080	.7494	1.4941	1.5025	34.9277
.100	2.606	1.999	.7673	1.4366	1.4509	33.5823
.200	2.176	1.777	.8168	1.2206	1.2694	28.5345
.300	1.931	1.639	.8484	1.0408	1.1345	24.3308
.400	1.769	1.541	.8710	.8943	1.0374	20.9054
.500	1.652	1.468	.8881	.7746	.9682	18.1072
.600	1.564	1.410	.9016	.6761	.9195	15.8052
.700	1.494	1.363	.9127	.5944	.8856	13.8945
.800	1.437	1.325	.9218	.5260	.8626	12.2955
.900	1.390	1.292	.9295	.4682	.8475	10.9457
1.000	1.351	1.264	.9361	.4191	.8382	9.7976
1.500	1.221	1.171	.9586	.2575	.8374	6.0231
2.000	1.152	1.118	.9712	.1723	.8615	4.0279
2.500	1.110	1.086	.9790	.1223	.8867	2.8591
5.000	1.035	1.028	.9933	.0368	.9559	.8595
10.000	1.010	1.008	.9982	.0098	.9872	.2285
25.000	1.002	1.001	.9997	.0016	.9978	.0373
100.000	1.000	1.000	1.0000	.0001	.9999	.0023

$\bar{\nu} = 1.970 \times 10^{11} \frac{\rho}{\rho_o} = 2.360 \times 10^8 P_{mmHg}$; $\nu_{DC} = 1.210 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 350^{o}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	γ	η	S
.000	3.614	2.423	.6705	1.6247	1.6247	32.7732
.025	3.311	2.307	.6966	1.5961	1.5971	32.1963
.050	3.006	2.179	.7249	1.5450	1.5488	31.1651
.075	2.782	2.079	.7471	1.4884	1.4967	30.0235
.100	2.610	1.997	.7652	1.4307	1.4451	28.8610
.200	2.174	1.773	.8154	1.2156	1.2642	24.5216
.300	1.928	1.633	.8472	1.0369	1.1302	20.9164
.400	1.764	1.535	.8700	.8914	1.0340	17.9808
.500	1.647	1.461	.8873	.7726	.9658	15.5850
.600	1.557	1.403	.9010	.6749	.9179	13.6144
.700	1.487	1.356	.9122	.5938	.8848	11.9790
.800	1.429	1.317	.9215	.5260	.8626	10.6101
.900	1.382	1.284	.9294	.4687	.8485	9.4542
1.000	1.342	1.256	.9361	.4199	.8398	8.4698
1.500	1.213	1.165	.9590	.2588	.8412	5.2211
2.000	1.144	1.112	.9718	.1732	.8661	3.4943
2.500	1.104	1.081	.9795	.1229	.8911	2.4795
5.000	1.033	1.026	.9935	.0369	.9583	.7435
10.000	1.009	1.007	.9982	.0098	.9880	.1973
25.000	1.001	1.001	.9997	.0016	.9980	.0322
100.000	1.000	1.000	1.0000	.0001	.9999	.0020

$\bar{\nu} = 2.283 \times 10^{11} \frac{\rho}{\rho_o} = 2.344 \times 10^{8} P_{mm\,Hg}$; $\nu_{DC} = 1.405 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (contd.)

WEAKLY IONIZED N_2

$T = 400^{\circ}K$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	δ
.000	3.651	2.429	.6655	1.6162	1.6162	28.7817
.025	3.319	2.303	.6938	1.5869	1.5879	28.2608
.050	3.005	2.173	.7229	1.5359	1.5397	27.3517
.075	2.778	2.071	.7455	1.4796	1.4879	26.3492
.100	2.603	1.989	.7638	1.4224	1.4366	25.3313
.200	2.166	1.764	.8143	1.2093	1.2577	21.5366
.300	1.918	1.624	.8465	1.0325	1.1254	18.3878
.400	1.754	1.525	.8694	.8886	1.0308	15.8247
.500	1.636	1.451	.8870	.7711	.9639	13.7326
.600	1.546	1.393	.9009	.6744	.9172	12.0109
.700	1.475	1.346	.9123	.5941	.8853	10.5810
.800	1.418	1.307	.9218	.5268	.8640	9.3822
.900	1.371	1.274	.9298	.4699	.8505	8.3681
1.000	1.332	1.247	.9365	.4211	.8423	7.5001
1.500	1.204	1.156	.9598	.2602	.8458	4.6346
2.000	1.138	1.106	.9725	.1742	.8708	3.1017
2.500	1.099	1.077	.9801	.1235	.8955	2.1998
5.000	1.031	1.024	.9938	.0369	.9604	.6578
10.000	1.008	1.007	.9983	.0098	.9886	.1743
25.000	1.001	1.001	.9997	.0016	.9981	.0284
100.000	1.000	1.000	1.0000	.0001	.9999	.0018

$\bar{\nu} = 2.586 \times 10^{11} \frac{\rho}{\rho_o} = 2.323 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 1.600 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (contd.)

WEAKLY IONIZED N_2

$T = 500^{o}K$

$\bar{\nu}/\omega$	α_1	α_2	α_3	γ	η	S
.000	3.677	2.420	.6582	1.5929	1.5929	23.1872
.025	3.301	2.279	.6905	1.5633	1.5643	22.7566
.050	2.979	2.146	.7206	1.5132	1.5170	22.0269
.075	2.749	2.044	.7437	1.4583	1.4665	21.2279
.100	2.574	1.962	.7623	1.4027	1.4167	20.4185
.200	2.136	1.738	.8137	1.1960	1.2458	17.4097
.300	1.889	1.599	.8463	1.0243	1.1165	14.9102
.400	1.726	1.501	.8698	.8845	1.0258	12.8730
.500	1.606	1.428	.8878	.7698	.9623	11.2060
.600	1.519	1.370	.9021	.6753	.9184	9.8296
.700	1.449	1.324	.9138	.5964	.8886	8.6612
.800	1.393	1.286	.9235	.5299	.8690	7.7137
.900	1.347	1.255	.9316	.4734	.8568	6.8910
1.000	1.309	1.229	.9386	.4250	.8499	6.1061
1.500	1.188	1.143	.9615	.2636	.8548	3.8266
2.000	1.126	1.097	.9739	.1759	.8794	2.5605
2.500	1.090	1.070	.9813	.1246	.9050	1.8132
5.000	1.026	1.022	.9943	.0371	.9638	.5396
10.000	1.007	1.006	.9985	.0098	.9897	.1426
25.000	1.001	1.001	.9997	.0016	.9963	.0232
100.000	1.000	1.000	1.0000	.0001	.9999	.0015

$\bar{\nu} = 3.163 \times 10^{11} \frac{\rho}{\rho_o} = 2.274 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 1.986 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 600^{\circ}K$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	s
.000	3.660	2.395	.6543	1.5669	1.5669	19.4665
.025	3.256	2.245	.6895	1.5378	1.5387	19.1056
.050	2.932	2.112	.7203	1.4894	1.4931	18.5043
.075	2.704	2.011	.7436	1.4364	1.4445	17.8465
.100	2.530	1.930	.7625	1.3828	1.3967	17.1808
.200	2.096	1.709	.8145	1.1836	1.2309	14.7054
.300	1.855	1.572	.8477	1.0177	1.1093	12.6440
.400	1.694	1.476	.8716	.8819	1.0250	10.9568
.500	1.578	1.404	.8899	.7702	.9628	9.5692
.600	1.491	1.349	.9044	.6774	.9213	8.4164
.700	1.424	1.304	.9161	.5995	.8953	7.4486
.800	1.370	1.268	.9258	.5335	.8749	6.6282
.900	1.326	1.239	.9339	.4771	.8635	5.9271
1.000	1.290	1.214	.9408	.4286	.8572	5.3250
1.500	1.176	1.133	.9633	.2654	.8626	3.2975
2.000	1.116	1.090	.9752	.1773	.8864	2.2025
2.500	1.064	1.065	.9823	.1254	.9090	1.5578
5.000	1.025	1.020	.9946	.0372	.9664	.4618
10.000	1.007	1.005	.9986	.0098	.9905	.1218
25.000	1.001	1.001	.9998	.0016	.9984	.0198
100.000	1.000	1.000	1.0000	.0001	.9999	.0012

$\bar{\nu} = 3.706 \times 10^{11} \frac{\rho}{\rho_o} = 2.220 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 2.365 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 700^{\circ}K$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	S
.000	3.621	2.363	.6525	1.5419	1.5419	16.8268
.025	3.200	2.208	.6900	1.5134	1.5144	16.5166
.050	2.878	2.076	.7212	1.4668	1.4705	16.0080
.075	2.653	1.976	.7449	1.4160	1.4240	15.4536
.100	2.482	1.896	.7639	1.3646	1.3783	14.8925
.200	2.058	1.680	.8164	1.1730	1.2199	12.8016
.300	1.819	1.546	.8500	1.0127	1.1039	11.0523
.400	1.662	1.453	.8742	.8808	1.0217	9.6123
.500	1.550	1.384	.8925	.7715	.9643	8.4193
.600	1.467	1.330	.9070	.6800	.9248	7.4211
.700	1.402	1.288	.9187	.6027	.8981	6.5777
.800	1.351	1.254	.9282	.5369	.8804	5.8589
.900	1.309	1.226	.9362	.4805	.8696	5.2434
1.000	1.275	1.202	.9429	.4318	.8636	4.7123
1.500	1.166	1.125	.9648	.2674	.8689	2.9178
2.000	1.111	1.085	.9763	.1784	.8918	1.9465
2.500	1.079	1.061	.9831	.1260	.9136	1.3752
5.000	1.024	1.019	.9949	.0372	.9683	.4065
10.000	1.006	1.005	.9986	.0098	.9910	.1071
25.000	1.001	1.001	.9998	.0016	.9985	.0174
100.000	1.000	1.000	1.0000	.0001	.9999	.0011

$\bar{\nu} = 4.219 \times 10^{11} \frac{\rho}{\rho_o} = 2.166 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 2.736 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 800^{\circ}K$

$\nu/\bar{\nu}$	α_1	α_2	α_3	γ	η	S
.000	3.569	2.328	.6523	1.5186	1.5186	14.8572
.025	3.138	2.170	.6915	1.4911	1.4920	14.5879
.050	2.821	2.040	.7231	1.4464	1.4500	14.1504
.075	2.601	1.943	.7469	1.3977	1.4055	13.6741
.100	2.434	1.864	.7661	1.3484	1.3619	13.1920
.200	2.019	1.653	.8189	1.1641	1.2107	11.3891
.300	1.786	1.523	.8527	1.0090	1.0998	9.8717
.400	1.634	1.433	.8769	.8804	1.0213	8.6132
.500	1.526	1.366	.8952	.7730	.9662	7.5626
.600	1.446	1.315	.9096	.6825	.9282	6.6773
.700	1.384	1.275	.9211	.6057	.9024	5.9254
.800	1.335	1.242	.9304	.5399	.8854	5.2819
.900	1.295	1.215	.9382	.4833	.8749	4.7288
1.000	1.262	1.192	.9448	.4345	.8690	4.2506
1.500	1.158	1.119	.9660	.2693	.8741	2.6313
2.000	1.106	1.080	.9772	.1793	.8963	1.7538
2.500	1.075	1.058	.9838	.1265	.9174	1.2380
5.000	1.023	1.018	.9951	.0373	.9700	.3650
10.000	1.006	1.005	.9987	.0098	.9915	.0960
25.000	1.001	1.001	.9998	.0016	.9986	.0156
100.000	1.000	1.000	1.0000	.0001	.9999	.0010

$\bar{\nu} = 4.706 \times 10^{11} \frac{\rho}{\rho_o} = 2.115 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 3.099 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 1000^{\circ}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	γ	η	δ
.000	3.452	2.259	.6545	1.4788	1.4788	12.1206
.025	3.013	2.099	.6964	1.4532	1.4541	11.9108
.050	2.710	1.974	.7284	1.4120	1.4156	11.5737
.075	2.500	1.881	.7524	1.3673	1.3750	11.2067
.100	2.341	1.807	.7717	1.3218	1.3351	10.8344
.200	1.948	1.607	.8248	1.1506	1.1966	9.4308
.300	1.729	1.484	.8586	1.0043	1.0947	8.2317
.400	1.587	1.400	.8825	.8809	1.0218	7.2200
.500	1.487	1.339	.9003	.7763	.9703	6.3625
.600	1.413	1.292	.9141	.6870	.9343	5.6310
.700	1.356	1.254	.9253	.6107	.9099	5.0054
.800	1.311	1.224	.9342	.5448	.8935	4.4657
.900	1.274	1.199	.9416	.4880	.8833	4.0001
1.000	1.243	1.178	.9478	.4387	.8774	3.5959
1.500	1.147	1.110	.9680	.2714	.8821	2.2245
2.000	1.098	1.074	.9786	.1806	.9031	1.4805
2.500	1.070	1.053	.9849	.1273	.9230	1.0434
5.000	1.021	1.016	.9954	.0374	.9722	.3065
10.000	1.006	1.004	.9988	.0098	.9922	.0805
25.000	1.001	1.001	.9998	.0016	.9987	.0131
100.000	1.000	1.000	1.0000	.0001	.9999	.0008

$\bar{\nu} = 5.718 \times 10^{11} \frac{\rho}{\rho_o} = 2.019 \times 10^{8} P_{mm\,Hg}$; $\nu_{Dc} = 3.799 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 1200^{\circ}K$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	S
.000	3.332	2.195	.6590	1.4467	1.4467	10.3121
.025	2.897	2.036	.7027	1.4229	1.4238	10.1424
.050	2.609	1.917	.7348	1.3850	1.3884	9.8718
.075	2.410	1.829	.7588	1.3436	1.3511	9.5768
.100	2.259	1.758	.7781	1.3014	1.3144	9.2763
.200	1.888	1.569	.8309	1.1410	1.1867	8.1329
.300	1.683	1.454	.8641	1.0015	1.0916	7.1385
.400	1.551	1.376	.8873	.8818	1.0229	6.2853
.500	1.458	1.319	.9046	.7791	.9738	5.5530
.600	1.389	1.275	.9179	.6906	.9392	4.9224
.700	1.336	1.240	.9284	.6143	.9154	4.3788
.800	1.293	1.212	.9370	.5484	.8994	3.9091
.900	1.259	1.188	.9441	.4914	.8894	3.5025
1.000	1.230	1.168	.9501	.4419	.8837	3.1495
1.500	1.139	1.104	.9695	.2732	.8878	1.9472
2.000	1.092	1.070	.9797	.1816	.9080	1.2944
2.500	1.065	1.050	.9856	.1279	.9270	.9114
5.000	1.020	1.015	.9956	.0375	.9738	.2670
10.000	1.005	1.004	.9988	.0098	.9926	.0701
25.000	1.001	1.001	.9998	.0016	.9988	.0114
100.000	1.000	1.000	1.0000	.0001	.9999	.0007

$\bar{\nu} = 6.460 \times 10^{11} \frac{\rho}{\rho_o} = 1.935 \times 10^8 P_{mmHg}$; $\nu_{DC} = 4.465 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 1400^{\circ}K$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	s
.000	3.220	2.139	.6644	1.4215	1.4215	9.0265
.025	2.794	1.982	.7094	1.3992	1.4001	8.8855
.050	2.521	1.869	.7414	1.3640	1.3674	8.6616
.075	2.332	1.785	.7653	1.3254	1.3329	8.4167
.100	2.190	1.718	.7844	1.2860	1.2988	8.1662
.200	1.840	1.539	.8366	1.1343	1.1797	7.2030
.300	1.648	1.432	.8690	.9999	1.0899	6.3498
.400	1.524	1.359	.8914	.8829	1.0242	5.6068
.500	1.437	1.305	.9080	.7813	.9766	4.9615
.600	1.372	1.263	.9208	.6933	.9429	4.4027
.700	1.321	1.230	.9310	.6172	.9196	3.9194
.800	1.281	1.203	.9393	.5512	.9040	3.5004
.900	1.248	1.180	.9462	.4940	.8942	3.1373
1.000	1.220	1.161	.9520	.4443	.8886	2.8213
1.500	1.133	1.100	.9706	.2745	.8921	1.7431
2.000	1.088	1.067	.9804	.1823	.9115	1.1576
2.500	1.063	1.048	.9861	.1282	.9297	.8143
5.000	1.019	1.015	.9959	.0375	.9747	.2381
10.000	1.005	1.004	.9989	.0098	.9929	.0624
25.000	1.001	1.001	.9998	.0016	.9988	.0101
100.000	1.000	1.000	1.0000	.0001	.9999	.0006

$\bar{\nu} = 7.251 \times 10^{11} \frac{\rho}{\rho_o} = 1.862 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 5.101 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 1600^{\circ}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	γ	η	δ
.000	3.120	2.091	.6702	1.4015	1.4015	8.0633
.025	2.705	1.937	.7161	1.3806	1.3815	7.9435
.050	2.445	1.829	.7479	1.3477	1.3510	7.7537
.075	2.266	1.749	.7716	1.3114	1.3188	7.5453
.100	2.132	1.685	.7905	1.2742	1.2870	7.3313
.200	1.801	1.516	.8417	1.1296	1.1748	6.4992
.300	1.620	1.415	.8732	.9992	1.0892	5.7490
.400	1.503	1.345	.8948	.8841	1.0256	5.0867
.500	1.421	1.294	.9108	.7833	.9792	4.5069
.600	1.359	1.254	.9231	.6956	.9460	4.0022
.700	1.310	1.223	.9330	.6195	.9250	3.5641
.800	1.272	1.197	.9410	.5534	.9076	3.1839
.900	1.240	1.175	.9477	.4960	.8977	2.8537
1.000	1.213	1.157	.9533	.4461	.8921	2.5664
1.500	1.150	1.097	.9715	.2754	.8950	1.5845
2.000	1.086	1.066	.9809	.1827	.9137	1.0513
2.500	1.061	1.047	.9865	.1285	.9313	.7391
5.000	1.019	1.015	.9960	.0375	.9751	.2158
10.000	1.005	1.004	.9989	.0098	.9929	.0566
25.000	1.001	1.001	.9998	.0016	.9988	.0092
100.000	1.000	1.000	1.0000	.0001	.9999	.0006

$\bar{\nu} = 8.003 \times 10^{11} \frac{\rho}{\rho_o} = 1.798 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 5.710 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 1800^{\circ}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	γ	η	S
.000	3.032	2.050	.6762	1.3864	1.3864	7.3142
.025	2.629	1.900	.7226	1.3667	1.3676	7.2106
.050	2.381	1.796	.7542	1.3357	1.3390	7.0465
.075	2.212	1.720	.7776	1.3014	1.3087	6.8656
.100	2.084	1.659	.7962	1.2660	1.2787	6.6790
.200	1.771	1.499	.8463	1.1269	1.1720	5.9451
.300	1.599	1.402	.8768	.9993	1.0893	5.2722
.400	1.488	1.336	.8977	.8855	1.0272	4.6715
.500	1.409	1.287	.9132	.7853	.9817	4.1432
.600	1.349	1.249	.9252	.6977	.9489	3.6811
.700	1.303	1.218	.9347	.6215	.9260	3.2787
.800	1.266	1.193	.9425	.5552	.9104	2.9288
.900	1.235	1.172	.9490	.4975	.9006	2.6249
1.000	1.209	1.154	.9544	.4474	.8948	2.3602
1.500	1.128	1.096	.9720	.2759	.8967	1.4557
2.000	1.086	1.066	.9813	.1829	.9145	.9650
2.500	1.061	1.047	.9867	.1285	.9317	.6780
5.000	1.019	1.015	.9960	.0375	.9749	.1978
10.000	1.005	1.004	.9989	.0098	.9928	.0519
25.000	1.001	1.001	.9998	.0016	.9988	.0084
100.000	1.000	1.000	1.0000	.0001	.9999	.0005

$\bar{\nu} = 8.728 \times 10^{11} \frac{\rho}{\rho_o} = 1.743 \times 10^{8} P_{mm\,Hg}$; $\nu_{DC} = 6.295 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XIV (Contd.)

WEAKLY IONIZED N_2

$T = 2000^{o}K$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3	γ	η	S
.000	2.958	2.017	.6819	1.3755	1.3755	6.7119
.025	2.565	1.870	.7288	1.3569	1.3578	6.6211
.050	2.329	1.770	.7601	1.3274	1.3307	6.4768
.075	2.167	1.697	.7831	1.2946	1.3019	6.3170
.100	2.045	1.639	.8014	1.2607	1.2733	6.1517
.200	1.747	1.486	.8503	1.1258	1.1709	5.4934
.300	1.584	1.394	.8798	1.0003	1.0903	4.8809
.400	1.478	1.330	.9001	.8872	1.0292	4.3293
.500	1.402	1.283	.9151	.7872	.9840	3.8409
.600	1.344	1.246	.9267	.6994	.9512	3.4129
.700	1.299	1.216	.9359	.6229	.9281	3.0393
.800	1.262	1.191	.9437	.5565	.9127	2.7156
.900	1.232	1.171	.9500	.4987	.9026	2.4332
1.000	1.208	1.154	.9553	.4483	.8965	2.1873
1.500	1.128	1.097	.9725	.2762	.8976	1.3476
2.000	1.087	1.067	.9816	.1829	.9147	.8926
2.500	1.062	1.048	.9868	.1285	.9314	.6268
5.000	1.020	1.016	.9959	.0375	.9741	.1828
10.000	1.006	1.004	.9989	.0098	.9924	.0479
25.000	1.001	1.001	.9998	.0016	.9987	.0078
100.000	1.000	1.000	1.0000	.0001	.9999	.0005

$\bar{\nu} = 9.437 \times 10^{11} \frac{\rho}{\rho_o} = 1.696 \times 10^{8} P_{mmHg}$; $\nu_{DC} = 6.860 \times 10^{11} \frac{\rho}{\rho_o}$

Table XV

Corrections to Weakly Ionized O_2

TABLE XV

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

T = 200°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	1.743	1.504	.8627	1.2974	1.2974	73.6743
.025	1.737	1.501	.8639	1.2940	1.2948	73.4775
.050	1.723	1.493	.8665	1.2841	1.2873	72.9172
.075	1.704	1.482	.8699	1.2688	1.2760	72.0503
.100	1.683	1.470	.8737	1.2492	1.2617	70.9363
.200	1.594	1.418	.8893	1.1443	1.1901	64.9791
.300	1.515	1.368	.9032	1.0243	1.1164	58.1624
.400	1.448	1.325	.9150	.9080	1.0532	51.5595
.500	1.394	1.289	.9249	.8025	1.0032	45.5726
.600	1.348	1.258	.9332	.7097	.9653	40.3032
.700	1.310	1.232	.9403	.6292	.9374	35.7270
.800	1.278	1.210	.9463	.5595	.9176	31.7735
.900	1.251	1.190	.9515	.4994	.9040	28.3608
1.000	1.227	1.173	.9560	.4475	.8950	25.4124

$\bar{\nu} = 0.811 \times 10^{11} \frac{\rho}{\rho_o} = 1.16 \times 10^{8} P_{mmHg} = 0.302 \times 10^{-8} N_{O_2}$ $\nu_{DC} = 6.25 \times 10^{10} \frac{\rho}{\rho_o}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
$T = 250^{\circ}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	1.834	1.561	.8511	1.3286	1.3286	62.7676
.025	1.827	1.557	.8524	1.3246	1.3254	62.5778
.050	1.809	1.548	.8555	1.3132	1.3165	62.0417
.075	1.784	1.535	.8594	1.2959	1.3031	61.2208
.100	1.760	1.520	.8637	1.2738	1.2865	60.1767
.200	1.655	1.459	.8812	1.1584	1.2048	54.7283
.300	1.564	1.402	.8965	1.0303	1.1230	48.6752
.400	1.489	1.354	.9093	.9089	1.0544	42.9407
.500	1.429	1.314	.9199	.8005	1.0006	37.8192
.600	1.378	1.280	.9288	.7062	.9604	33.3624
.700	1.337	1.252	.9364	.6249	.9311	29.5213
.800	1.301	1.227	.9428	.5551	.9103	26.2225
.900	1.272	1.206	.9483	.4951	.8961	23.3881
1.000	1.246	1.187	.9530	.4434	.8868	20.9469

$\bar{\nu} = 0.975 \times 10^{11} \frac{\rho}{\rho_0} = 1.401 \times 10^{8} P_{mmHg} = 0.363 \times 10^{-8} N_{O_2}$ $\qquad \nu_{DC} = 7.34 \times 10^{10} \frac{\rho}{\rho_0}$

TABLE XV (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

T = 300°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	1.916	1.611	.8407	1.3540	1.3540	54.7993
.025	1.906	1.606	.8423	1.3494	1.3502	54.6148
.050	1.885	1.594	.8458	1.3366	1.3400	54.0981
.075	1.857	1.579	.8503	1.3173	1.3247	53.3145
.100	1.827	1.562	.8551	1.2929	1.3058	52.3278
.200	1.706	1.492	.8744	1.1685	1.2152	47.2937
.300	1.604	1.429	.8911	1.0342	1.1273	41.8570
.400	1.522	1.377	.9047	.9089	1.0543	36.7846
.500	1.455	1.333	.9159	.7982	.9978	32.3081
.600	1.401	1.297	.9253	.7029	.9560	28.4497
.700	1.356	1.266	.9333	.6213	.9257	25.1452
.800	1.319	1.239	.9400	.5515	.9044	22.3195
.900	1.287	1.217	.9458	.4916	.8899	19.8985
1.000	1.259	1.197	.9508	.4403	.8805	17.8188
1.500	1.167	1.130	.9680	.2691	.8745	10.8903
2.000	1.116	1.091	.9778	.1784	.8919	7.2198
2.500	1.084	1.067	.9838	.1257	.9112	5.0870
5.000	1.027	1.022	.9948	.0371	.9654	1.5028
10.000	1.007	1.006	.9986	.0098	.9899	.3967
25.000	1.001	1.001	.9998	.0016	.9983	.0645
100.000	1.000	1.000	1.0000	.0001	.9999	.0040

$\bar{\nu} = 1.138 \times 10^{11} \frac{\rho}{\rho_0} = 1.363 \times 10^{8} P_{mmHg} = 0.424 \times 10^{-8} N_{O_2}$ $\qquad \nu_{DC} = 8.40 \times 10^{10} \frac{\rho}{\rho_0}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
T = 350°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	1.987	1.653	.8316	1.3742	1.3742	48.6985
.025	1.976	1.647	.8334	1.3691	1.3700	48.5187
.050	1.951	1.634	.8374	1.3550	1.3584	48.0191
.075	1.919	1.616	.8424	1.3338	1.3413	47.2686
.100	1.884	1.597	.8477	1.3074	1.3205	46.3325
.200	1.748	1.519	.8686	1.1754	1.2224	41.6528
.300	1.636	1.450	.8863	1.0357	1.1289	36.7041
.400	1.547	1.394	.9008	.9077	1.0529	32.1664
.500	1.476	1.347	.9127	.7959	.9949	28.2052
.600	1.418	1.308	.9225	.7001	.9521	24.8084
.700	1.370	1.276	.9308	.6183	.9213	21.9119
.800	1.331	1.248	.9378	.5486	.8998	19.4424
.900	1.297	1.224	.9439	.4891	.8852	17.3319
1.000	1.268	1.204	.9491	.4380	.8759	15.5206
1.500	1.172	1.133	.9670	.2679	.8708	9.4951
2.000	1.119	1.093	.9770	.1778	.8888	6.2992
2.500	1.086	1.068	.9833	.1254	.9091	4.4437
5.000	1.028	1.022	.9947	.0371	.9647	1.3148
10.000	1.008	1.006	.9985	.0098	.9897	.3473
25.000	1.001	1.001	.9998	.0016	.9983	.0565
100.000	1.000	1.000	1.0000	.0001	.9999	.0035

$\bar{\nu} = 1.299 \times 10^{11} \frac{\rho}{\rho_o} = 1.334 \times 10^{8} P_{mmHg} = 0.483 \times 10^{-8} N_{O_2}$ $\nu_{DC} = 9.46 \times 10^{10} \frac{\rho}{\rho_o}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
$T = 400^{\circ}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.050	1.688	.8235	1.3900	1.3900	43.8658
.025	2.037	1.681	.8255	1.3944	1.3855	43.6905
.050	2.007	1.666	.8300	1.3691	1.3725	43.2068
.075	1.971	1.647	.8355	1.3463	1.3559	42.4871
.100	1.932	1.625	.8413	1.3181	1.3313	41.5971
.200	1.782	1.559	.8638	1.1797	1.2269	37.2301
.300	1.661	1.466	.8825	1.0362	1.1295	32.7019
.400	1.566	1.406	.8977	.9062	1.0512	28.5999
.500	1.491	1.357	.9101	.7937	.9921	25.0474
.600	1.430	1.316	.9203	.6976	.9488	22.0161
.700	1.380	1.282	.9289	.6159	.9177	19.4371
.800	1.339	1.253	.9362	.5465	.8963	17.2480
.900	1.304	1.229	.9425	.4872	.8819	15.3763
1.000	1.274	1.207	.9479	.4364	.8727	13.7713
1.500	1.174	1.135	.9663	.2672	.8686	8.4340
2.000	1.121	1.094	.9766	.1774	.8872	5.6000
2.500	1.087	1.069	.9830	.1252	.9380	3.9526
5.000	1.028	1.022	.9946	.0371	.9644	1.1706
10.000	1.008	1.006	.9985	.0098	.9897	.3092
25.000	1.001	1.001	.9998	.0016	.9983	.0503
100.000	1.000	1.000	1.0000	.0001	.9999	.0032

$$\bar{\nu} = 1.459 \times 10^{11} \frac{\rho}{\rho_0} = 1.311 \times 10^{8} P_{mmHg} = 0.543 \times 10^{-8} N_{O_2} \qquad \nu_{DC} = 1.05 \times 10^{11} \frac{\rho}{\rho_0}$$

TABLE XV (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

$T = 500^{o}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.152	1.743	.8099	1.4117	1.4117	36.6854
.025	2.135	1.735	.8125	1.4053	1.4062	36.5184
.050	2.098	1.716	.8178	1.3879	1.3913	36.0648
.075	2.053	1.692	.8242	1.3623	1.3700	35.4013
.100	2.005	1.666	.8310	1.3312	1.3446	34.5936
.200	1.831	1.567	.8562	1.1834	1.2308	30.7528
.300	1.694	1.465	.8767	1.0350	1.1281	26.8953
.400	1.590	1.420	.8931	.9030	1.0475	23.4657
.500	1.508	1.367	.9064	.7899	.9874	20.5270
.600	1.443	1.324	.9173	.6940	.9459	18.0354
.700	1.390	1.288	.9264	.6128	.9151	15.9252
.800	1.347	1.258	.9341	.5439	.8919	14.1329
.900	1.310	1.232	.9407	.4851	.8780	12.6047
1.000	1.279	1.210	.9464	.4346	.8692	11.2937
1.500	1.176	1.135	.9655	.2667	.8666	6.9293
2.000	1.125	1.094	.9763	.1773	.8867	4.6084
2.500	1.087	1.068	.9828	.1252	.9077	3.2535
5.000	1.028	1.022	.9946	.0371	.9647	.9641
10.000	1.009	1.006	.9985	.0098	.9898	.2547
25.000	1.001	1.001	.9998	.0016	.9983	.0414
100.000	1.000	1.000	1.0000	.0001	.9999	.0026

$\bar{\nu} = 1.772 \times 10^{11} \frac{\rho}{\rho_o} = 1.274 \times 10^{8} P_{mmHg} = 0.659 \times 10^{-8} N_{o_2}$ $\nu_{DC} = 1.26 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XV (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

$T = 600^\circ K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.229	1.782	.7992	1.4240	1.4240	31.5981
.025	2.208	1.771	.8022	1.4168	1.4177	31.4393
.050	2.164	1.749	.8084	1.3976	1.4011	31.0139
.075	2.110	1.722	.8157	1.3700	1.3777	30.4015
.100	2.056	1.692	.8233	1.3369	1.3502	29.6657
.200	1.860	1.583	.8509	1.1831	1.2304	26.2536
.300	1.712	1.495	.8729	1.0324	1.1253	22.9085
.400	1.601	1.425	.8903	.9000	1.0440	19.9704
.500	1.515	1.370	.9043	.7872	.9840	17.4675
.600	1.447	1.325	.9157	.6918	.9409	15.3523
.700	1.393	1.288	.9252	.6112	.9107	13.5622
.800	1.348	1.258	.9331	.5427	.8900	12.0423
.900	1.310	1.231	.9399	.4842	.8764	10.7440
1.000	1.278	1.209	.9457	.4341	.8681	9.6321
1.500	1.174	1.134	.9654	.2667	.8669	5.9191
2.000	1.119	1.092	.9763	.1775	.8876	3.9392
2.500	1.086	1.067	.9828	.1254	.9086	2.7616
5.000	1.027	1.021	.9946	.0371	.9654	.8240
10.000	1.007	1.006	.9985	.0098	.9931	.2175
25.000	1.001	1.001	.9998	.0016	.9983	.0354
100.000	1.000	1.000	1.0000	.0001	.9999	.0022

$\bar{\nu} = 2.075 \times 10^{11} \frac{\rho}{\rho_0} = 1.243 \times 10^8 P_{mmHg} = 0.772 \times 10^{-8} N_{O_2}$ $\nu_{DC} = 1.46 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
$T = 700^\circ K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.257	1.808	.7907	1.4296	1.4296	27.8064
.025	2.262	1.796	.7942	1.4219	1.4228	27.6556
.050	2.218	1.770	.8012	1.4014	1.4049	27.2569
.075	2.150	1.740	.8093	1.3722	1.3799	26.6902
.100	2.089	1.700	.8175	1.3377	1.3510	26.0178
.200	1.976	1.590	.8473	1.1806	1.2270	22.9626
.300	1.720	1.497	.8705	1.0292	1.1219	20.0187
.400	1.604	1.425	.8887	.8973	1.0408	17.4522
.500	1.515	1.369	.9051	.7852	.9815	15.2728
.600	1.446	1.323	.9149	.6906	.9392	13.4314
.700	1.396	1.286	.9246	.6104	.9096	11.8733
.800	1.345	1.254	.9328	.5423	.8894	10.5481
.900	1.307	1.228	.9397	.4842	.8764	9.4175
1.000	1.275	1.206	.9456	.4342	.8685	8.4458
1.500	1.171	1.131	.9655	.2672	.8684	5.1971
2.000	1.116	1.090	.9764	.1779	.8894	3.4596
2.500	1.063	1.065	.9830	.1256	.9106	2.4429
5.000	1.026	1.020	.9948	.0372	.9665	.7231
10.000	1.007	1.006	.9986	.0098	.9904	.1907
25.000	1.001	1.001	.9998	.0016	.9984	.0310
100.000	1.000	1.000	1.0000	.0001	.9999	.0019

$\bar{\nu} = 2.367 \times 10^{11} \frac{\rho}{\rho_o} = 1.215 \times 10^{8} P_{mmHg} = 0.881 \times 10^{-8} N_{O_2}$ $\quad\quad$ $\nu_{bc} = 1.66 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
T = 800°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.328	1.825	.7839	1.4309	1.4309	24.8717
.025	2.300	1.812	.7873	1.4226	1.4235	24.7286
.050	2.242	1.783	.7954	1.4008	1.4043	24.3495
.075	2.175	1.750	.8044	1.3709	1.3786	23.8297
.100	2.109	1.715	.8133	1.3354	1.3488	23.2131
.200	1.863	1.590	.8648	1.1768	1.2239	20.4554
.300	1.720	1.495	.8690	1.0259	1.1162	17.8322
.400	1.602	1.422	.8877	.8949	1.0381	15.5550
.500	1.512	1.364	.9026	.7838	.9790	13.6250
.600	1.442	1.318	.9146	.6899	.9342	11.9914
.700	1.385	1.281	.9246	.6105	.9094	10.6086
.800	1.340	1.250	.9328	.5426	.8898	9.4309
.900	1.302	1.224	.9399	.4846	.8772	8.4243
1.000	1.270	1.201	.9458	.4348	.8696	7.5563
1.500	1.167	1.127	.9658	.2679	.8706	4.6562
2.000	1.113	1.087	.9768	.1784	.8918	3.1003
2.500	1.080	1.062	.9833	.1259	.9150	2.1889
5.000	1.025	1.019	.9949	.0372	.9677	.6470
10.000	1.007	1.005	.9986	.0098	.9909	.1705
25.000	1.001	1.001	.9998	.0016	.9985	.0277
100.000	1.000	1.000	1.0000	.0001	.9999	.0017

$\bar{\nu} = 2.649 \times 10^{11} \frac{\rho}{\rho_o} = 1.190 \times 10^8 P_{mmHg} = 0.986 \times 10^{-8} N_{O_2}$ $\nu_{DC} = 1.85 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XV (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

$T = 900°K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.358	1.835	.7785	1.4288	1.4288	22.5345
.025	2.325	1.820	.7828	1.4202	1.4211	22.3987
.050	2.261	1.789	.7913	1.3980	1.4015	22.0479
.075	2.190	1.753	.8007	1.3670	1.3747	21.5603
.100	2.119	1.717	.8102	1.3311	1.3444	20.9929
.200	1.882	1.567	.8432	1.1723	1.2192	18.4884
.300	1.716	1.490	.8682	1.0225	1.1145	16.1266
.400	1.595	1.416	.8874	.8928	1.0357	14.0815
.500	1.505	1.358	.9026	.7828	.9785	12.3457
.600	1.435	1.312	.9148	.6896	.9379	10.8763
.700	1.379	1.275	.9248	.6105	.9097	9.6289
.800	1.333	1.244	.9332	.5431	.8907	8.5655
.900	1.296	1.218	.9403	.4854	.8786	7.6558
1.000	1.264	1.196	.9463	.4357	.8714	6.8717
1.500	1.162	1.123	.9663	.2686	.8731	4.2370
2.000	1.109	1.083	.9772	.1789	.8945	2.8216
2.500	1.078	1.060	.9837	.1263	.9155	1.9915
5.000	1.024	1.018	.9950	.0373	.9690	.5878
10.000	1.006	1.005	.9987	.0098	.9912	.1548
25.000	1.001	1.001	.9998	.0016	.9985	.0252
100.000	1.000	1.000	1.0000	.0001	.9999	.0016

$\bar{\nu} = 2.919 \times 10^{11} \frac{\rho}{\rho_0} = 1.166 \times 10^{8} P_{mm\,Hg} = 1.086 \times 10^{-8} N_{O_2}$ $\qquad \nu_{DC} = 2.04 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
T = 1000°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.377	1.840	.7742	1.4244	1.4244	20.6297
.025	2.341	1.824	.7789	1.4156	1.4164	20.5010
.050	2.272	1.790	.7880	1.3928	1.3963	20.1714
.075	2.196	1.752	.7981	1.3615	1.3692	19.7182
.100	2.121	1.714	.8080	1.3253	1.3385	19.1935
.200	1.877	1.561	.8423	1.1673	1.2140	16.9056
.300	1.708	1.463	.8680	1.0192	1.1109	14.7608
.400	1.587	1.409	.8875	.8910	1.0336	12.9346
.500	1.496	1.351	.9029	.7821	.9776	11.3267
.600	1.427	1.306	.9152	.6896	.9379	9.9675
.700	1.371	1.269	.9253	.6111	.9105	8.8501
.800	1.326	1.238	.9337	.5439	.8921	7.8778
.900	1.288	1.212	.9409	.4865	.8805	7.0452
1.000	1.257	1.190	.9469	.4368	.8736	6.3260
1.500	1.157	1.119	.9668	.2696	.8761	5.9042
2.000	1.105	1.060	.9776	.1795	.8975	2.5995
2.500	1.074	1.057	.9840	.1266	.9181	1.8341
5.000	1.022	1.017	.9952	.0373	.9704	.5405
10.000	1.006	1.005	.9987	.0098	.9917	.1422
25.000	1.001	1.001	.9998	.0016	.9986	.0231
100.000	1.000	1.000	1.0000	.0001	.9999	.0014

$\bar{\nu} = 3.179 \times 10^{11} \frac{\rho}{\rho_o} = 1.143 \times 10^{8} P_{mmHg} = 1.183 \times 10^{-8} N_{O_2}$ $\nu_{Dc} = 2.23 \times 10^{11} \frac{\rho}{\rho_c}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
T = 1200°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.391	1.837	.7682	1.4112	1.4112	17.7178
.025	2.350	1.818	.7737	1.4020	1.4029	17.6021
.050	2.273	1.782	.7839	1.3788	1.3823	17.3108
.075	2.190	1.741	.7949	1.3473	1.3549	16.9159
.100	2.110	1.700	.8057	1.3115	1.3246	16.4660
.200	1.857	1.563	.8420	1.1570	1.2032	14.5257
.300	1.686	1.465	.8686	1.0130	1.1041	12.7178
.400	1.566	1.391	.8886	.8880	1.0301	11.1493
.500	1.477	1.335	.9042	.7813	.9766	9.8091
.600	1.408	1.291	.9166	.6903	.9388	8.6670
.700	1.354	1.254	.9268	.6126	.9128	7.6915
.800	1.310	1.225	.9351	.5459	.8953	6.8542
.900	1.273	1.200	.9423	.4888	.8847	6.1365
1.000	1.243	1.179	.9483	.4392	.8784	5.5140
1.500	1.147	1.110	.9681	.2715	.8822	3.4081
2.000	1.097	1.074	.9786	.1807	.9035	2.2687
2.500	1.069	1.052	.9849	.1274	.9236	1.5995
5.000	1.020	1.016	.9955	.0374	.9728	.4698
10.000	1.005	1.004	.9988	.0098	.9924	.1234
25.000	1.001	1.001	.9998	.0016	.9987	.0200
100.000	1.000	1.000	1.0000	.0001	.9999	.0013

$\bar{\nu} = 3.667 \times 10^{11} \dfrac{\rho}{\rho_o} = 1.099 \times 10^{8} P_{mmHg} = 1.365 \times 10^{-8} N_{O_2}$ $\qquad \nu_{DC} = 2.60 \times 10^{11} \dfrac{\rho}{\rho_o}$

TABLE XV (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

T = 1400°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.384	1.823	.7649	1.3947	1.3947	15.5996
.025	2.338	1.803	.7710	1.3854	1.3863	15.4953
.050	2.255	1.764	.7821	1.3623	1.3657	15.2373
.075	2.168	1.721	.7940	1.3314	1.3389	14.8919
.100	2.086	1.690	.8054	1.2964	1.3094	14.5002
.200	1.830	1.542	.8430	1.1466	1.1925	12.8248
.300	1.660	1.445	.8701	1.0072	1.0978	11.2653
.400	1.542	1.373	.8904	.8856	1.0273	9.9049
.500	1.455	1.318	.9060	.7810	.9763	8.7358
.600	1.386	1.275	.9185	.6914	.9404	7.7337
.700	1.336	1.240	.9286	.6146	.9157	6.8738
.800	1.293	1.212	.9371	.5485	.8995	6.1347
.900	1.256	1.188	.9440	.4913	.8893	5.4953
1.000	1.229	1.168	.9530	.4418	.8836	4.9417
1.500	1.137	1.102	.9694	.2734	.8886	3.0581
2.000	1.089	1.067	.9796	.1819	.9096	2.0347
2.500	1.063	1.048	.9857	.1281	.9289	1.4330
5.000	1.018	1.014	.9958	.0375	.9751	.4195
10.000	1.005	1.004	.9989	.0098	.9951	.1100
25.000	1.001	1.001	.9998	.0016	.9989	.0178
100.000	1.000	1.000	1.0000	.0001	.9999	.0011

$\bar{\nu} = 4.117 \times 10^{11} \frac{\rho}{\rho_0} = 1.057 \times 10^{8} P_{mmHg} = 1.532 \times 10^{-8} N_{O_2}$ $\nu_{oc} = 2.95 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
$T = 1600°K$

$\omega/\bar{\nu}$	α_1	α_2	α_2	Y	η	S
.000	2.363	1.804	.7634	1.3770	1.3770	13.9933
.025	2.314	1.762	.77[illegible]1	1.3677	1.3666	13.8990
.050	2.227	1.741	.7820	1.3450	1.3484	13.6682
.075	2.137	1.698	.7945	1.3150	1.3224	13.3630
.100	2.053	1.656	.8163	1.2811	1.2939	13.0187
.200	1.799	1.520	.8449	1.1368	1.1623	11.5521
.300	1.633	1.424	.8723	1.0020	1.0922	10.1822
.400	1.517	1.354	.8926	.8835	1.0249	8.9785
.500	1.433	1.302	.9182	.7811	.9764	7.9376
.600	1.369	1.260	.92[illegible]5	.6928	.9422	7.0404
.700	1.318	1.226	.93[illegible]7	.6167	.9188	6.2666
.800	1.277	1.199	.9390	.5509	.9035	5.5986
.900	1.243	1.176	.9459	.4940	.8941	5.0199
1.000	1.215	1.157	.9518	.4445	.8889	4.5166
1.500	1.127	1.094	.9708	.2753	.8947	2.7975
2.000	1.083	1.062	.9808	.1830	.9151	1.8599
2.500	1.058	1.044	.9865	.1288	.9356	1.3086
5.000	1.017	1.013	.9951	.0376	.9770	.3819
10.000	1.004	1.003	.9990	.0098	.9937	.1000
25.000	1.001	1.001	.9998	.0016	.9990	.0162
100.000	1.000	1.000	1.0000	.0001	.9999	.0010

$\bar{\nu} = 4.531 \times 10^{11} \frac{\rho}{\rho_0} = 1.018 \times 10^{8} P_{mmHg} = 1.686 \times 10^{-8} N_{O_2}$ $\qquad \nu_{Dc} = 3.29 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XV (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)
$T = 1800°K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.333	1.781	.7633	1.3591	1.3591	12.7329
.025	2.282	1.758	.7704	1.3500	1.3508	12.6474
.050	2.192	1.716	.7831	1.3283	1.3316	12.4441
.075	2.101	1.673	.7961	1.2993	1.3066	12.1722
.100	2.010	1.631	.8083	1.2666	1.2793	11.8666
.200	1.767	1.497	.8474	1.1279	1.1730	10.5668
.300	1.605	1.404	.8749	.9975	1.0873	9.3451
.400	1.494	1.337	.8952	.8821	1.0232	8.2639
.500	1.412	1.286	.9107	.7815	.9769	7.3219
.600	1.350	1.246	.9230	.6944	.9444	6.5055
.700	1.301	1.214	.9329	.6189	.9222	5.7984
.800	1.262	1.167	.9411	.5535	.9077	5.1852
.900	1.230	1.166	.9479	.4966	.8988	4.6524
1.000	1.203	1.147	.9536	.4470	.8941	4.1881
1.500	1.119	1.088	.9721	.2770	.9002	2.5949
2.000	1.078	1.058	.9817	.1840	.9198	1.7235
2.500	1.054	1.041	.9873	.1293	.9376	1.2116
5.000	1.016	1.012	.9963	.0376	.9779	.3524
10.000	1.004	1.003	.9990	.0098	.9941	.0922
25.000	1.001	1.001	.9998	.0016	.9990	.0150
100.000	1.000	1.000	1.0000	.0001	.9999	.0009

$\bar{\nu} = 4.915 \times 10^{11} \frac{\rho}{\rho_o} = 0.981 \times 10^{8} P_{mmHg} = 1.829 \times 10^{-8} N_{o_2}$ $\nu_{DC} = 3.62 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XV (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED O_2 (MODEL I)

$T = 2000^{\circ}K$

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.297	1.756	.7645	1.3424	1.3424	11.7257
.025	2.244	1.733	.7721	1.3335	1.3343	11.6479
.050	2.154	1.691	.7851	1.3121	1.3154	11.4612
.075	2.063	1.647	.7984	1.2842	1.2914	11.2171
.100	1.980	1.606	.8108	1.2529	1.2654	10.9437
.200	1.735	1.475	.8503	1.1195	1.1643	9.7791
.300	1.579	1.386	.8777	.9934	1.0828	8.6770
.400	1.471	1.321	.8979	.8808	1.0218	7.6940
.500	1.392	1.271	.9132	.7821	.9776	6.8316
.600	1.332	1.233	.9253	.6960	.9466	6.0797
.700	1.285	1.202	.9351	.6211	.9255	5.4255
.800	1.248	1.177	.9431	.5559	.9117	4.8558
.900	1.217	1.156	.9498	.4991	.9034	4.3597
1.000	1.192	1.138	.9554	.4495	.8989	3.9260
1.500	1.112	1.082	.9734	.2786	.9054	2.4335
2.000	1.072	1.054	.9827	.1849	.9245	1.6151
2.500	1.050	1.038	.9879	.1298	.9414	1.1342
5.000	1.014	1.011	.9965	.0377	.9800	.3292
10.000	1.004	1.003	.9991	.0098	.9945	.0860
25.000	1.001	1.000	.9999	.0016	.9991	.0139
100.000	1.000	1.000	1.0000	.0001	.9999	.0009

$\bar{\nu} = 5.271 \times 10^{11} \frac{\rho}{\rho_0} = 0.947 \times 10^{8} P_{mmHg} = 1.962 \times 10^{-8} N_{O_2}$ $\qquad \nu_{DC} = 3.93 \times 10^{11} \frac{\rho}{\rho_0}$

Table XVI

Corrections to Weakly Ionized Air

TABLE XVI
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 200°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.837	2.092	.7376	1.5433	1.5433	59.2084
.025	2.751	2.055	.7471	1.5283	1.5293	58.6338
.050	2.613	1.992	.7626	1.4939	1.4977	57.3143
.075	2.482	1.930	.7776	1.4508	1.4589	55.6584
.100	2.369	1.874	.7911	1.4038	1.4178	53.8551
.200	2.046	1.702	.8319	1.2129	1.2614	46.5327
.300	1.844	1.585	.8597	1.0435	1.1374	40.0352
.400	1.704	1.500	.8801	.9014	1.0456	34.5804
.500	1.602	1.435	.8959	.7832	.9790	30.0484
.600	1.523	1.383	.9085	.6849	.9315	26.2778
.700	1.460	1.341	.9187	.6027	.8981	23.1237
.800	1.409	1.306	.9272	.5335	.8750	20.4685
.900	1.367	1.277	.9344	.4749	.8595	18.2185
1.000	1.331	1.252	.9405	.4248	.8497	16.2991

$\bar{\nu} = 1.200 \times 10^{11} \frac{\rho}{\rho_0} = 2.157 \times 10^{8} P_{mm\,Hg}$ $\qquad$ $\nu_{DC} = 7.78 \times 10^{10} \frac{\rho}{\rho_0}$

TABLE XVI (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)

T = 250°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.967	2.154	.7258	1.5631	1.5631	48.2674
.025	2.857	2.107	.7375	1.5460	1.5470	47.7408
.050	2.693	2.034	.7552	1.5084	1.5122	46.5790
.075	2.546	1.965	.7716	1.4626	1.4709	45.1661
.100	2.423	1.904	.7859	1.4133	1.4274	43.6417
.200	2.078	1.722	.8284	1.2161	1.2648	37.5539
.300	1.867	1.600	.8569	1.0437	1.1376	32.2287
.400	1.723	1.512	.8778	.9000	1.0440	27.7906
.500	1.617	1.445	.8938	.7811	.9764	24.1204
.600	1.535	1.392	.9065	.6825	.9282	21.0763
.700	1.471	1.348	.9169	.6003	.8944	18.5366
.800	1.418	1.313	.9256	.5312	.8711	16.4029
.900	1.375	1.282	.9329	.4727	.8556	14.5977
1.000	1.338	1.256	.9391	.4229	.8459	13.0599
1.500	1.216	1.168	.9603	.2591	.8420	8.0007
2.000	1.150	1.118	.9722	.1728	.8640	5.3359
2.500	1.110	1.087	.9796	.1225	.8878	3.7814
5.000	1.035	1.029	.9934	.0368	.9555	1.1349
10.000	1.010	1.008	.9982	.0098	.9369	.3017
25.000	1.002	1.001	.9997	.0016	.9978	.0492
100.000	1.000	1.000	1.0000	.0001	.9999	.0031

$$\bar{\nu} = 1.491 \times 10^{11} \frac{\rho}{\rho_o} = 2.144 \times 10^{8} P_{mmHg} \qquad \nu_{DC} = 9.54 \times 10^{10} \frac{\rho}{\rho_o}$$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 300°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.065	2.195	.7164	1.5727	1.5727	40.7574
.025	2.930	2.140	.7302	1.5541	1.5550	40.2735
.050	2.746	2.059	.7495	1.5144	1.5181	39.2449
.075	2.589	1.985	.7668	1.4667	1.4749	38.0091
.100	2.457	1.921	.7817	1.4158	1.4300	36.6917
.200	2.097	1.731	.8255	1.2153	1.2639	31.4934
.300	1.880	1.606	.8546	1.0415	1.1352	26.9909
.400	1.731	1.516	.8758	.8974	1.0410	23.2569
.500	1.623	1.448	.8920	.7786	.9733	20.1783
.600	1.539	1.393	.9050	.6803	.9252	17.6306
.700	1.473	1.349	.9155	.5984	.8917	15.5089
.800	1.420	1.312	.9244	.5297	.8688	13.7280
.900	1.375	1.281	.9318	.4716	.8537	12.2225
1.000	1.337	1.255	.9382	.4222	.8443	10.9403
1.500	1.213	1.165	.9599	.2593	.8427	6.7193
2.000	1.146	1.114	.9722	.1732	.8658	4.4876
2.500	1.106	1.084	.9797	.1228	.8902	3.1821
5.000	1.034	1.027	.9935	.0368	.9573	.9542
10.000	1.009	1.007	.9982	.0098	.9876	.2534
25.000	1.002	1.001	.9997	.0016	.9979	.0413
100.000	1.000	1.000	1.0000	.0001	.9999	.0026

$\bar{\nu} = 1.777 \times 10^{11} \frac{\rho}{\rho_o} = 2.129 \times 10^{8} P_{mm\,Hg}$ $\nu_{DC} = 1.13 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)

CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)

T = 350°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.135	2.222	.7088	1.5749	1.5749	35.2866
.025	2.980	2.159	.7244	1.5551	1.5560	34.8421
.050	2.780	2.071	.7451	1.5141	1.5179	33.9236
.075	2.613	1.994	.7631	1.4653	1.4736	32.8316
.100	2.476	1.927	.7784	1.4137	1.4279	31.6753
.200	2.105	1.733	.8232	1.2118	1.2602	27.1501
.300	1.883	1.606	.8528	1.0381	1.1315	23.2585
.400	1.732	1.514	.8743	.8945	1.0376	20.0421
.500	1.622	1.444	.8908	.7764	.9705	17.3951
.600	1.537	1.389	.9040	.6787	.9230	15.2070
.700	1.470	1.344	.9147	.5974	.8902	13.3860
.800	1.415	1.307	.9238	.5293	.8680	11.8582
.900	1.370	1.276	.9314	.4716	.8536	10.5663
1.000	1.331	1.249	.9379	.4224	.8449	9.4651
1.500	1.207	1.159	.9602	.2601	.8453	5.8278
2.000	1.141	1.109	.9725	.1739	.8693	3.8955
2.500	1.102	1.080	.9801	.1233	.8937	2.7618
5.000	1.032	1.025	.9937	.0369	.9592	.8266
10.000	1.009	1.007	.9983	.0098	.9882	.2192
25.000	1.001	1.001	.9997	.0016	.9980	.0357
100.000	1.000	1.000	1.0000	.0001	.9999	.0022

$\bar{\nu} = 2.055 \times 10^{11} \frac{\rho}{\rho_0} = 2.110 \times 10^{8} P_{mmHg}$ $\qquad$ $\nu_{cD} = 1.30 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 400°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.184	2.237	.7026	1.5719	1.5719	31.1295
.025	3.010	2.167	.7199	1.5512	1.5522	30.7198
.050	2.798	2.075	.7416	1.5094	1.5132	29.8923
.075	2.625	1.995	.7602	1.4602	1.4685	28.9180
.100	2.484	1.927	.7759	1.4083	1.4224	27.8895
.200	2.105	1.729	.8215	1.2067	1.2549	23.8964
.300	1.880	1.600	.8515	1.0341	1.1271	20.4785
.400	1.727	1.508	.8734	.8917	1.0343	17.6584
.500	1.615	1.438	.8902	.7746	.9683	15.3401
.600	1.529	1.382	.9036	.6779	.9219	13.4242
.700	1.462	1.337	.9146	.5973	.8900	11.8288
.800	1.407	1.299	.9238	.5296	.8686	10.4888
.900	1.361	1.268	.9315	.4723	.8549	9.3538
1.000	1.323	1.241	.9382	.4234	.8469	8.3857
1.500	1.200	1.153	.9607	.2612	.8490	5.1731
2.000	1.135	1.105	.9731	.1746	.8732	3.4584
2.500	1.097	1.076	.9805	.1238	.8973	2.4509
5.000	1.030	1.024	.9939	.0370	.9610	.7320
10.000	1.008	1.007	.9983	.0098	.9887	.1939
25.000	1.001	1.001	.9997	.0016	.9981	.0316
100.000	1.000	1.000	1.0000	.0001	.9999	.0020

$\bar{\nu} = 2.325 \times 10^{11} \frac{\rho}{\rho_0} = 2.089 \times 10^{8}{}_{mmHg}$ $\qquad \nu_{DC} = 1.48 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 500°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.237	2.246	.6937	1.5580	1.5580	25.2446
.025	3.033	2.165	.7138	1.5363	1.5373	24.8930
.050	2.804	2.067	.7370	1.4940	1.4978	24.2082
.075	2.623	1.984	.7564	1.4448	1.4530	23.4111
.100	2.477	1.914	.7728	1.3934	1.4074	22.5782
.200	2.089	1.713	.8197	1.1952	1.2431	19.3668
.300	1.861	1.583	.8506	1.0264	1.1187	16.6304
.400	1.706	1.490	.8730	.8872	1.0292	14.3761
.500	1.594	1.419	.8904	.7728	.9659	12.5212
.600	1.508	1.364	.9042	.6779	.9220	10.9847
.700	1.441	1.319	.9155	.5987	.8921	9.7010
.800	1.387	1.283	.9249	.5318	.8721	8.6166
.900	1.342	1.252	.9329	.4750	.8598	7.6969
1.000	1.305	1.226	.9397	.4263	.8526	6.9076
1.500	1.186	1.142	.9621	.2636	.8566	4.2705
2.000	1.126	1.097	.9743	.1761	.8804	2.8532
2.500	1.090	1.070	.9815	.1247	.9037	2.0198
5.000	1.028	1.022	.9943	.0371	.9640	.6008
10.000	1.007	1.006	.9985	.0098	.9897	.1588
25.000	1.001	1.001	.9997	.0016	.9983	.0258
100.000	1.000	1.000	1.0000	.0001	.9999	.0016

$\bar{\nu} = 2.842 \times 10^{11} \frac{\rho}{\rho_o} = 2.043 \times 10^{8} P_{mm\,Hg}$ $\qquad \nu_{DC} = 1.82 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 600°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.251	2.237	.6881	1.5395	1.5395	21.2917
.025	3.024	2.148	.7104	1.5175	1.5184	20.9873
.050	2.786	2.047	.7348	1.4756	1.4793	20.4080
.075	2.600	1.963	.7548	1.4273	1.4354	19.7406
.100	2.452	1.892	.7716	1.3771	1.3909	19.0455
.200	2.062	1.691	.8197	1.1842	1.2315	16.3775
.300	1.834	1.561	.8512	1.0200	1.1118	14.1075
.400	1.680	1.469	.8742	.8845	1.0261	12.2334
.500	1.569	1.400	.8919	.7726	.9658	10.6855
.600	1.485	1.345	.9060	.6795	.9241	9.3970
.700	1.419	1.302	.9174	.6012	.8957	8.3143
.800	1.367	1.267	.9269	.5348	.8770	7.3962
.900	1.324	1.238	.9347	.4781	.8653	6.6116
1.000	1.288	1.213	.9415	.4294	.8587	5.9382
1.500	1.176	1.133	.9636	.2656	.8632	3.6734
2.000	1.118	1.090	.9754	.1773	.8866	2.4523
2.500	1.084	1.065	.9824	.1254	.9090	1.7340
5.000	1.026	1.020	.9946	.0372	.9663	.5140
10.000	1.007	1.005	.9985	.0098	.9904	.1356
25.000	1.001	1.001	.9998	.0016	.9984	.0221
100.000	1.000	1.000	1.0000	.0001	.9999	.0014

$\bar{\nu} = 3.329 \times 10^{11} \frac{\rho}{\rho_o} = 1.994 \times 10^{8} P_{mmHg}$ $\nu_{DC} = 2.16 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 700°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.241	2.220	.6849	1.5202	1.5202	18.4624
.025	2.997	2.125	.7091	1.4983	1.4992	18.1962
.050	2.754	2.022	.7343	1.4572	1.4609	17.6977
.075	2.567	1.938	.7548	1.4102	1.4181	17.1268
.100	2.419	1.867	.7719	1.3614	1.3750	16.5343
.200	2.031	1.667	.8208	1.1745	1.2215	14.2639
.300	1.805	1.539	.8529	1.0152	1.1065	12.3292
.400	1.654	1.449	.8762	.8831	1.0244	10.7255
.500	1.545	1.382	.8940	.7734	.9668	9.3930
.600	1.464	1.329	.9081	.6815	.9268	8.2766
.700	1.400	1.288	.9195	.6038	.8997	7.3333
.800	1.350	1.254	.9289	.5376	.8817	6.5296
.900	1.309	1.226	.9367	.4810	.8706	5.8416
1.000	1.274	1.202	.9433	.4322	.8643	5.2484
1.500	1.167	1.126	.9649	.2674	.8689	3.2470
2.000	1.112	1.085	.9763	.1783	.8915	2.1655
2.500	1.079	1.061	.9831	.1260	.9132	1.5298
5.000	1.024	1.019	.9949	.0372	.9681	.4522
10.000	1.006	1.005	.9986	.0098	.9910	.1192
25.000	1.001	1.001	.9998	.0016	.9985	.0194
100.000	1.000	1.000	1.0000	.0001	.9999	.0012

$\bar{\nu} = 3.791 \times 10^{11} \frac{\rho}{\rho_o} = 1.947 \times 10^{8} P_{mm\,Hg}$ $\qquad \nu_{DC} = 2.49 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 800°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.216	2.198	.6832	1.5014	1.5014	16.3398
.025	2.960	2.099	.7089	1.4798	1.4807	16.1043
.050	2.716	1.996	.7347	1.4398	1.4434	15.6690
.075	2.529	1.911	.7557	1.3942	1.4020	15.1732
.100	2.382	1.841	.7731	1.3470	1.3605	14.6595
.200	1.999	1.644	.8226	1.1661	1.2128	12.6909
.300	1.776	1.519	.8550	1.0114	1.1025	11.0075
.400	1.629	1.431	.8785	.8824	1.0236	9.6033
.500	1.524	1.366	.8963	.7745	.9681	8.4290
.600	1.445	1.315	.9103	.6835	.9296	7.4391
.700	1.384	1.275	.9216	.6063	.9034	6.5985
.800	1.335	1.243	.9308	.5403	.8861	5.8799
.900	1.296	1.216	.9385	.4836	.8753	5.2627
1.000	1.263	1.193	.9449	.4346	.8691	4.7293
1.500	1.159	1.120	.9660	.2688	.8737	2.9256
2.000	1.107	1.082	.9770	.1790	.8949	1.9479
2.500	1.076	1.058	.9837	.1265	.9169	1.3763
5.000	1.023	1.018	.9951	.0373	.9697	.4059
10.000	1.006	1.005	.9987	.0098	.9914	.1068
25.000	1.001	1.001	.9998	.0016	.9986	.0174
100.000	1.000	1.000	1.0000	.0001	.9999	.0011

$\bar{\nu} = 4.231 \times 10^{11} \frac{\rho}{\rho_0} = 1.901 \times 10^{8} P_{mmHg}$ $\qquad \nu_{DC} = 2.82 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 900°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.184	2.174	.6827	1.4839	1.4839	14.6900
.025	2.919	2.072	.7097	1.4626	1.4635	14.4791
.050	2.675	1.969	.7361	1.4238	1.4273	14.0951
.075	2.490	1.885	.7573	1.3797	1.3875	13.6587
.100	2.344	1.816	.7749	1.3341	1.3474	13.2070
.200	1.967	1.623	.8249	1.1590	1.2054	11.4739
.300	1.750	1.500	.8575	1.0086	1.0994	9.9851
.400	1.607	1.415	.8809	.8823	1.0234	8.7342
.500	1.505	1.352	.8986	.7758	.9698	7.6805
.600	1.429	1.304	.9124	.6856	.9324	6.7871
.700	1.370	1.265	.9235	.6087	.9069	6.0257
.800	1.323	1.234	.9326	.5427	.8900	5.3723
.900	1.285	1.208	.9401	.4858	.8793	4.8095
1.000	1.253	1.186	.9464	.4366	.8733	4.3225
1.500	1.154	1.115	.9670	.2701	.8777	2.6736
2.000	1.102	1.078	.9779	.1799	.8993	1.7806
2.500	1.073	1.056	.9843	.1269	.9198	1.2560
5.000	1.022	1.017	.9952	.0373	.9709	.3697
10.000	1.006	1.005	.9987	.0098	.9918	.0972
25.000	1.001	1.001	.9998	.0016	.9986	.0158
100.000	1.000	1.000	1.0000	.0001	.9999	.0010

$\bar{\nu} = 4.651 \times 10^{11} \frac{\rho}{\rho_o} = 1.857 \times 10^{8} P_{mmHg}$

$\nu_{DC} = 3.13 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 1000°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.146	2.149	.6830	1.4676	1.4676	13.3712
.025	2.876	2.045	.7111	1.4468	1.4477	13.1814
.050	2.633	1.943	.7379	1.4092	1.4127	12.8392
.075	2.450	1.860	.7593	1.3665	1.3742	12.4505
.100	2.307	1.792	.7771	1.3225	1.3357	12.0490
.200	1.937	1.603	.8274	1.1529	1.1991	10.5045
.300	1.725	1.484	.8600	1.0064	1.0969	9.1689
.400	1.587	1.401	.8832	.8823	1.0235	8.0386
.500	1.488	1.340	.9007	.7771	.9714	7.0800
.600	1.415	1.294	.9143	.6874	.9349	6.2629
.700	1.358	1.256	.9252	.6106	.9099	5.5636
.800	1.312	1.226	.9342	.5448	.8934	4.9634
.900	1.275	1.201	.9415	.4879	.8830	4.4448
1.000	1.245	1.180	.9477	.4385	.8770	3.9954
1.500	1.148	1.111	.9679	.2712	.8813	2.4706
2.000	1.099	1.075	.9785	.1805	.9024	1.6444
2.500	1.070	1.054	.9848	.1272	.9223	1.1591
5.000	1.021	1.016	.9954	.0374	.9720	.3406
10.000	1.006	1.004	.9988	.0098	.9921	.0895
25.000	1.001	1.001	.9998	.0016	.9987	.0145
100.000	1.000	1.000	1.0000	.0001	.9999	.0009

$\bar{\nu} = 5.054 \times 10^{11} \frac{\rho}{\rho_o} = 1.816 \times 10^{8} P_{mmHg}$ $\qquad$ $\nu_{DC} = 3.44 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 1200°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	3.064	2.100	.6853	1.4389	1.4389	11.3959
.025	2.788	1.994	.7152	1.4192	1.4201	11.2402
.050	2.550	1.894	.7426	1.3840	1.3874	10.9611
.075	2.374	1.814	.7643	1.3441	1.3517	10.6457
.100	2.236	1.749	.7822	1.3029	1.3159	10.3188
.200	1.883	1.568	.8326	1.1432	1.1889	9.0540
.300	1.683	1.456	.8648	1.0031	1.0934	7.9444
.400	1.553	1.378	.8876	.8827	1.0239	6.9910
.500	1.460	1.321	.9045	.7793	.9742	6.1724
.600	1.391	1.277	.9177	.6906	.9392	5.4695
.700	1.338	1.242	.9282	.6141	.9151	4.8641
.800	1.295	1.213	.9368	.5482	.8990	4.3415
.900	1.261	1.190	.9439	.4911	.8888	3.8892
1.000	1.232	1.170	.9499	.4415	.8830	3.4969
1.500	1.140	1.105	.9693	.2730	.8871	2.1619
2.000	1.093	1.071	.9795	.1815	.9074	1.4374
2.500	1.066	1.050	.9855	.1278	.9266	1.0122
5.000	1.020	1.015	.9956	.0374	.9737	.2966
10.000	1.005	1.004	.9988	.0098	.9926	.0778
25.000	1.001	1.001	.9998	.0016	.9988	.0126
100.000	1.000	1.000	1.0000	.0001	.9999	.0008

$\bar{\nu} = 5.814 \times 10^{11} \frac{\rho}{\rho_0} = 1.741 \times 10^{8} P_{mmHg}$ $\qquad \nu_{DC} = 4.04 \times 10^{11} \frac{\rho}{\rho_0}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 1400°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.982	2.055	.6890	1.4155	1.4155	9.9876
.025	2.705	1.948	.7202	1.3967	1.3976	9.8552
.050	2.475	1.851	.7479	1.3637	1.3671	9.6217
.075	2.306	1.775	.7697	1.3262	1.3337	9.3577
.100	2.174	1.712	.7876	1.2874	1.3003	9.0836
.200	1.838	1.539	.8376	1.1360	1.1814	8.0151
.300	1.649	1.433	.8693	1.0010	1.0911	7.0628
.400	1.526	1.360	.8913	.8833	1.0246	6.2325
.500	1.439	1.306	.9078	.7813	.9767	5.5129
.600	1.374	1.265	.9205	.6931	.9426	4.8904
.700	1.323	1.231	.9307	.6169	.9192	4.3526
.800	1.282	1.204	.9390	.5509	.9035	3.8872
.900	1.249	1.181	.9459	.4937	.8935	3.4833
1.000	1.221	1.162	.9517	.4440	.8879	3.1325
1.500	1.134	1.100	.9705	.2744	.8917	1.9359
2.000	1.089	1.067	.9803	.1823	.9113	1.2859
2.500	1.063	1.048	.9861	.1282	.9296	.9048
5.000	1.019	1.015	.9958	.0375	.9748	.2645
10.000	1.005	1.004	.9989	.0098	.9929	.0694
25.000	1.001	1.001	.9998	.0016	.9988	.0113
100.000	1.000	1.000	1.0000	.0001	.9999	.0007

$\bar{\nu} = 6.526 \times 10^{11} \frac{\rho}{\rho_o} = 1.675 \times 10^{8} P_{mm\,Hg}$ $\quad \nu_{DC} = 4.61 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 1600°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.905	2.014	.6933	1.3963	1.3963	8.9297
.025	2.630	1.908	.7255	1.3785	1.3795	8.8156
.050	2.409	1.814	.7533	1.3472	1.3506	8.6159
.075	2.246	1.741	.7751	1.3119	1.3193	8.3900
.100	2.120	1.681	.7929	1.2752	1.2879	8.1549
.200	1.800	1.516	.8422	1.1305	1.1758	7.2301
.300	1.622	1.416	.8731	.9996	1.0895	6.3925
.400	1.505	1.346	.8946	.8840	1.0255	5.6535
.500	1.422	1.295	.9105	.7830	.9788	5.0077
.600	1.360	1.255	.9228	.6953	.9456	4.4463
.700	1.311	1.223	.9327	.6191	.9225	3.9594
.800	1.272	1.197	.9408	.5531	.9071	3.5372
.900	1.240	1.175	.9475	.4958	.8973	3.1705
1.000	1.214	1.157	.9531	.4459	.8917	2.8513
1.500	1.129	1.097	.9714	.2754	.8950	1.7612
2.000	1.086	1.065	.9809	.1828	.9139	1.1689
2.500	1.061	1.046	.9865	.1285	.9317	.8218
5.000	1.018	1.014	.9960	.0375	.9754	.2399
10.000	1.005	1.004	.9989	.0098	.9931	.0629
25.000	1.001	1.001	.9998	.0016	.9989	.0102
100.000	1.000	1.000	1.0000	.0001	.9999	.0006

$\bar{\nu} = 7.200 \times 10^{11} \frac{\rho}{\rho_o} = 1.617 \times 10^{8} P_{mm\,Hg}$ $\qquad \nu_{Dc} = 5.16 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 1800°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.836	1.979	.6979	1.3813	1.3813	8.1055
.025	2.564	1.874	.7309	1.3642	1.3651	8.0056
.050	2.350	1.783	.7588	1.3346	1.3380	7.8319
.075	2.194	1.712	.7804	1.3011	1.3084	7.6351
.100	2.074	1.655	.7980	1.2661	1.2788	7.4297
.200	1.770	1.498	.8465	1.1270	1.1721	6.6136
.300	1.600	1.402	.8765	.9990	1.0889	5.8625
.400	1.489	1.336	.8974	.8851	1.0267	5.1936
.500	1.409	1.287	.9129	.7849	.9811	4.6057
.600	1.349	1.248	.9249	.6973	.9483	4.0919
.700	1.303	1.217	.9345	.6211	.9254	3.6447
.800	1.265	1.192	.9423	.5549	.9101	3.2565
.900	1.234	1.171	.9488	.4974	.9003	2.9188
1.000	1.208	1.153	.9543	.4473	.8946	2.6250
1.500	1.127	1.095	.9721	.2761	.8972	1.6200
2.000	1.085	1.065	.9814	.1831	.9154	1.0744
2.500	1.060	1.046	.9868	.1286	.9325	.7548
5.000	1.018	1.014	.9960	.0375	.9755	.2202
10.000	1.005	1.004	.9989	.0098	.9930	.0577
25.000	1.001	1.001	.9998	.0016	.9988	.0094
100.000	1.000	1.000	1.0000	.0001	.9999	.0006

$\bar{\nu} = 7.847 \times 10^{11} \frac{\rho}{\rho_o} = 1.567 \times 10^{8} P_{mm\,Hg}$ $\qquad \nu_{DC} = 5.68 \times 10^{11} \frac{\rho}{\rho_o}$

TABLE XVI (Cont'd.)
CORRECTIONS TO WEAKLY IONIZED AIR (MODEL I)
T = 2000°K

$\omega/\bar{\nu}$	α_1	α_2	α_3	Y	η	S
.000	2.775	1.950	.7026	1.3697	1.3697	7.4422
.025	2.507	1.846	.7362	1.3535	1.3543	7.3538
.050	2.301	1.758	.7639	1.3252	1.3285	7.2002
.075	2.151	1.689	.7854	1.2932	1.3005	7.0263
.100	2.036	1.634	.8028	1.2596	1.2722	6.8440
.200	1.745	1.484	.8503	1.1249	1.1699	6.1121
.300	1.583	1.392	.8796	.9993	1.0893	5.4297
.400	1.477	1.329	.8998	.8863	1.0282	4.8158
.500	1.400	1.281	.9149	.7864	.9830	4.2730
.600	1.342	1.244	.9265	.6990	.9506	3.7977
.700	1.297	1.214	.9357	.6225	.9276	3.3825
.800	1.260	1.189	.9436	.5564	.9126	3.0234
.900	1.230	1.169	.9499	.4987	.9027	2.7097
1.000	1.205	1.151	.9553	.4484	.8968	2.4364
1.500	1.126	1.095	.9726	.2765	.8987	1.5024
2.000	1.084	1.065	.9817	.1832	.9161	.9954
2.500	1.060	1.047	.9869	.1287	.9328	.6991
5.000	1.019	1.015	.9960	.0375	.9751	.2038
10.000	1.005	1.004	.9989	.0098	.9928	.0534
25.000	1.001	1.001	.9998	.0016	.9988	.0087
100.000	1.000	1.000	1.0000	.0001	.9999	.0005

$\bar{\nu} = 8.474 \times 10^{11} \frac{\rho}{\rho_0} = 1.523 \times 10^{8} p_{mm\,Hg}$ $\qquad \nu_{Dc} = 6.19 \times 10^{11} \frac{\rho}{\rho_0}$

Table XVII

Corrections to Weakly Ionized Gases Having $\nu = Av^n$

TABLE XVII

CORRECTIONS TO WEAKLY IONIZED
GASES HAVING $\nu = Av^n$

$$Q = Q_0 v^{n-1} \quad , \qquad \nu = Av^n$$

$$n = -3.0$$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3
0	6.5625	4.7203	.7193
.001	6.5619	4.7201	.7193
.025	6.2945	4.5927	.7296
.050	5.8340	4.3626	.7478
.075	5.4096	4.1398	.7653
.100	5.0528	3.9445	.7807
.200	4.1105	3.3918	.8252
.300	3.5757	3.0515	.8534
.400	3.2261	2.8172	.8732
.500	2.9767	2.6436	.8881
.600	2.7881	2.5085	.8997
.700	2.6395	2.3995	.9091
.800	2.5187	2.3092	.9168
.900	2.4183	2.2329	.9234
1.000	2.3332	2.1674	.9289
1.500	2.0451	1.9389	.9481
2.000	1.8755	1.7992	.9593
5.000	1.4899	1.4651	.9834
10.000	1.3123	1.3023	.9924
25.000	1.1708	1.1680	.9976
50.000	1.1079	1.1068	.9991
100.000	1.0680	1.0676	.9997
000.000	1.0146	1.0146	1.0000

$$\nu_{DC}/\bar{\nu} = \frac{3\pi}{32} = 0.2945$$

TABLE XVII (Cont)

$n = -2.5$

$\omega/\bar{\nu}$	α_1	α_2	α_3
.000	3.6998	2.8972	.7831
.025	3.6632	2.8778	.7856
.050	3.5729	2.8294	.7919
.075	3.4595	2.7671	.7999
.100	3.3418	2.7010	.8083
.200	2.9363	2.4617	.8384
.300	2.6496	2.2816	.8611
.400	2.4428	2.1456	.8783
.500	2.2869	2.0396	.8918
.600	2.1649	1.9542	.9027
.700	2.0664	1.8838	.9116
.800	1.9851	1.8245	.9191
.900	1.9166	1.7739	.9255
1.000	1.8581	1.7299	.9310
1.500	1.6571	1.5745	.9501
2.000	1.5377	1.4784	.9614
5.000	1.2692	1.2506	.9854
10.000	1.1524	1.1453	.9939
25.000	1.0684	1.0667	.9983
50.000	1.0363	1.0357	.9994
100.000	1.0189	1.0187	.9998
1000.000	1.0020	1.0020	1.0000

$\nu_{DC}/\bar{\nu} = 0.4408$

TABLE XVII (Cont)

$n = -2.0$

ε/ν	α_1	α_2	α_3
.000	2.3333	1.9720	.8452
.025	2.3276	1.9686	.8458
.050	2.3113	1.9590	.8476
.075	2.2868	1.9445	.8503
.100	2.2567	1.9264	.8536
.200	2.1180	1.8409	.8692
.300	1.9890	1.7582	.8840
.400	1.8818	1.6872	.8966
.500	1.7939	1.6274	.9072
.600	1.7213	1.5768	.9161
.700	1.6606	1.5338	.9236
.800	1.6092	1.4966	.9300
.900	1.5651	1.4643	.9356
1.000	1.5269	1.4360	.9405
1.500	1.3929	1.3338	.9576
2.000	1.3122	1.2699	.9678
5.000	1.1344	1.1219	.9890
10.000	1.0643	1.0599	.9959
25.000	1.0217	1.0208	.9991
50.000	1.0090	1.0087	.9997
100.000	1.0035	1.0035	.9999
1000.000	1.0001	1.0001	1.0000

$$\nu_{DC}/\bar{\nu} = \alpha_1/\alpha_2^2 = \frac{3}{5} = 0.6000$$

TABLE XVII (Cont)

$n = -1.5$

$\varepsilon/\bar{\nu}$	α_1	α_2	α_3
.000	1.6274	1.4688	.9026
.025	1.6261	1.4681	.9028
.050	1.6230	1.4661	.9033
.075	1.6179	1.4627	.9041
.100	1.6111	1.4583	.9052
.200	1.5722	1.4527	.9113
.300	1.5257	1.4014	.9186
.400	1.4798	1.3701	.9258
.500	1.4379	1.3409	.9325
.600	1.4006	1.3145	.9385
.700	1.3676	1.2910	.9438
.800	1.3390	1.2700	.9485
.900	1.3136	1.2513	.9526
1.000	1.2911	1.2347	.9563
1.500	1.2101	1.1732	.9695
2.000	1.1605	1.1344	.9775
5.000	1.0562	1.0491	.9933
10.000	1.0214	1.0192	.9978
25.000	1.0050	1.0046	.9996
50.000	1.0015	1.0014	.9999
100.000	1.0004	1.0004	1.0000
1000.000	1.0000	1.0000	1.0000

$$\nu_{0c}/\bar{\nu} = \alpha_1/\alpha_2^2 = 0.7543$$

TABLE XVII (Cont)

$n = -1.0$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3
.000	1.2500	1.1694	.9515
.025	1.2496	1.1693	.9516
.050	1.2491	1.1688	.9517
.075	1.2480	1.1680	.9519
.100	1.2465	1.1670	.9522
.200	1.2371	1.1603	.9541
.300	1.2238	1.1708	.9567
.400	1.2086	1.1600	.9598
.500	1.1931	1.1468	.9628
.600	1.1781	1.1378	.9658
.700	1.1640	1.1275	.9686
.800	1.1511	1.1179	.9712
.900	1.1393	1.1092	.9735
1.000	1.1286	1.1012	.9757
1.500	1.0889	1.0710	.9835
2.000	1.0645	1.0520	.9883
5.000	1.0174	1.0144	.9971
10.000	1.0052	1.0044	.9992
25.000	1.0009	1.0008	.9999
50.000	1.0002	1.0002	1.0000
100.000	1.0001	1.0000	1.0000
1000.000	1.0000	1.0000	1.0000

$$\nu_{DC}/\bar{\nu} = \frac{9\pi}{32} = 0.8836$$

TABLE XVII (Cont)

$n = -.5$

$\bar{\omega}/\bar{\nu}$	α_1	α_2	α_3
.000	1.0598	1.0454	.9864
.025	1.0598	1.0454	.9864
.050	1.0597	1.0453	.9864
.075	1.0595	1.0452	.9865
.100	1.0593	1.0450	.9865
.200	1.0576	1.0437	.9869
.300	1.0550	1.0419	.9875
.400	1.0519	1.0395	.9882
.500	1.0484	1.0369	.9890
.600	1.0448	1.0342	.9898
.700	1.0413	1.0316	.9907
.800	1.0379	1.0290	.9914
.900	1.0348	1.0266	.9922
1.000	1.0318	1.0244	.9928
1.500	1.0208	1.0160	.9953
2.000	1.0142	1.0110	.9968
5.000	1.0030	1.0023	.9993
10.000	1.0008	1.0006	.9998
25.000	1.0001	1.0001	1.0000
50.000	1.0000	1.0000	1.0000
100.000	1.0000	1.0000	1.0000
1000.000	1.0000	1.0000	1.0000

$\nu_{DC}/\bar{\nu} = \alpha_1/\alpha_2^2 = 0.9697$

TABLE XVII (Cont)

$n = .0$

$\varepsilon/\bar{\nu}$	α_1	α_2	α_3
.000	1.0000	1.0000	1.0000
.025	1.0000	1.0000	1.0000
.050	1.0000	1.0000	1.0000
.075	1.0000	1.0000	1.0000
.100	1.0000	1.0000	1.0000
.200	1.0000	1.0000	1.0000
.300	1.0000	1.0000	1.0000
.400	1.0000	1.0000	1.0000
.500	1.0000	1.0000	1.0000
.600	1.0000	1.0000	1.0000
.700	1.0000	1.0000	1.0000
.800	1.0000	1.0000	1.0000
.900	1.0000	1.0000	1.0000
1.000	1.0000	1.0000	1.0000
1.500	1.0000	1.0000	1.0000
2.000	1.0000	1.0000	1.0000
5.000	1.0000	1.0000	1.0000
10.000	1.0000	1.0000	1.0000
25.000	1.0000	1.0000	1.0000
50.000	1.0000	1.0000	1.0000
100.000	1.0000	1.0000	1.0000
1000.000	1.0000	1.0000	1.0000

$\nu_{DC}/\bar{\nu} = 1$

TABLE XVII (Cont)

$n = .5$

$\omega/\bar{\nu}$	α_1	α_2	α_3
.000	1.0679	1.0494	.9827
.025	1.0678	1.0493	.9827
.050	1.0676	1.0492	.9828
.075	1.0672	1.0489	.9829
.100	1.0668	1.0486	.9830
.200	1.0636	1.0464	.9838
.300	1.0592	1.0433	.9849
.400	1.0542	1.0397	.9862
.500	1.0491	1.0360	.9876
.600	1.0441	1.0324	.9888
.700	1.0395	1.0291	.9900
.800	1.0354	1.0261	.9910
.900	1.0317	1.0234	.9920
1.000	1.0284	1.0210	.9928
1.500	1.0171	1.0127	.9957
2.000	1.0110	1.0082	.9972
5.000	1.0021	1.0016	.9995
10.000	1.0006	1.0004	.9999
25.000	1.0001	1.0001	1.0000
50.000	1.0000	1.0000	1.0000
100.000	1.0000	1.0000	1.0000
1000.000	1.0000	1.0000	1.0000

$\nu_{DC}/\bar{\nu} = 0.9697$

TABLE XVII (Cont)

$n = 1.0$

$\omega/\bar{\nu}$	α_1	α_2	α_3
.000	1.3333	1.2284	.9213
.025	1.3317	1.2275	.9218
.050	1.3274	1.2250	.9229
.075	1.3214	1.2214	.9244
.100	1.3142	1.2171	.9261
.200	1.2803	1.1962	.9342
.300	1.2462	1.1742	.9423
.400	1.2155	1.1540	.9494
.500	1.1888	1.1360	.9556
.600	1.1660	1.1205	.9609
.700	1.1466	1.1070	.9654
.800	1.1300	1.0953	.9693
.900	1.1158	1.0853	.9726
1.000	1.1036	1.0766	.9755
1.500	1.0626	1.0470	.9851
2.000	1.0413	1.0311	.9902
5.000	1.0083	1.0063	.9980
10.000	1.0022	1.0017	.9995
25.000	1.0004	1.0003	.9999
50.000	1.0001	1.0001	1.0000
100.000	1.0000	1.0000	1.0000
1000.000	1.0000	1.0000	1.0000

$$\nu_{DC}/\bar{\nu} = \frac{9\pi}{32} = 0.8836$$

TABLE XVII (Cont)

$n = 1.5$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3
.000	2.0863	1.6631	.7971
.025	2.0247	1.6361	.8081
.050	1.9580	1.6045	.8195
.075	1.8969	1.5742	.8299
.100	1.8419	1.5458	.8392
.200	1.6706	1.4516	.8688
.300	1.5521	1.3814	.8900
.400	1.4649	1.3273	.9061
.500	1.3980	1.2844	.9187
.600	1.3453	1.2497	.9289
.700	1.3027	1.2210	.9373
.800	1.2676	1.1970	.9443
.900	1.2383	1.1766	.9502
1.000	1.2136	1.1592	.9552
1.500	1.1326	1.1009	.9720
2.000	1.0896	1.0689	.9810
5.000	1.0196	1.0153	.9959
10.000	1.0052	1.0041	.9989
25.000	1.0006	1.0006	.9998
50.000	1.0001	1.0001	1.0000
100.000	1.0000	.9999	1.0000
1000.000	.9999	.9999	1.0000

$\nu_{DC}/\bar{\nu} = 0.7543$

TABLE XVII (Cont)

$n = 2.0$

$\nu/\bar{\varepsilon}$	α_1	α_2	α_3
.000	4.9997	2.8866	.5774
.025	3.6016	2.4279	.6741
.050	3.1688	2.2541	.7113
.075	2.8914	2.1627	.7376
.100	2.6894	2.0387	.7581
.200	2.2086	1.7942	.8124
.300	1.9477	1.6475	.8459
.400	1.7781	1.5460	.8695
.500	1.6575	1.4706	.8873
.600	1.5666	1.4119	.9013
.700	1.4955	1.3648	.9126
.800	1.4382	1.3260	.9220
.900	1.3912	1.2936	.9298
1.000	1.3518	1.2660	.9365
1.500	1.2242	1.1739	.9590
2.000	1.1558	1.1227	.9714
5.000	1.0379	1.0308	.9931
10.000	1.0107	1.0087	.9981
25.000	1.0018	1.0015	.9997
50.000	1.0004	1.0004	.9999
100.000	1.0001	1.0001	1.0000
1000.000	1.0000	1.0000	1.0000

$\nu_{DC}/\bar{\nu} = \frac{3}{5} = 0.6000$

TABLE XVII (Cont)

n = 2.5

$\varepsilon/\bar{\nu}$	α_1	α_2	α_3
0	∞	∞	--
.025	6.3882	3.6/17	.5748
.050	4.9821	3.1659	.6354
.075	4.2610	2.8728	.6742
.100	3.7979	2.6695	.7029
.200	2.8518	2.2070	.7739
.300	2.4076	1.9625	.8151
.400	2.1388	1.8038	.8434
.500	1.9555	1.6902	.8643
.600	1.8213	1.6039	.8807
.700	1.7182	1.5357	.8938
.800	1.6363	1.4803	.9047
.900	1.5696	1.4342	.9138
1.000	1.5141	1.3953	.9215
1.500	1.3355	1.2656	.9477
2.000	1.2392	1.1928	.9625
5.000	1.0650	1.0544	.9900
10.000	1.0195	1.0165	.9971
25.000	1.0034	1.0029	.9995
50.000	1.0009	1.0007	.9999
100.000	1.0002	1.0002	1.0000
1000.000	1.0000	1.0000	1.0000

$\nu_{DC}/\bar{\nu} = 0.4408$

TABLE XVII (Cont)

$n = 3.0$

$\frac{\omega}{\bar{\nu}}$	α_1	α_2	α_3
0	∞	∞	0
.001	44.1736	12.0599	.2730
.025	10.2779	5.3446	.5200
.050	7.2564	4.3080	.5937
.075	5.8990	3.7703	.6392
.100	5.0892	3.4202	.6721
.200	3.5721	2.6845	.7515
.300	2.9182	2.3244	.7965
.400	2.5391	2.0998	.8270
.500	2.2871	1.9428	.8494
.600	2.1057	1.8255	.8669
.700	1.9681	1.7338	.8809
.800	1.8596	1.6597	.8925
.900	1.7716	1.5986	.9023
1.000	1.6990	1.5471	.9106
1.500	1.4656	1.3760	.9388
2.000	1.3395	1.2793	.9551
5.000	1.1026	1.0878	.9868
10.000	1.0334	1.0291	.9959
25.000	1.0061	1.0054	.9993
50.000	1.0016	1.0014	.9998
100.000	1.0004	1.0003	1.0000
1000.000	1.0000	1.0000	1.0000

$$\nu_{Dc}/\bar{\nu} = \frac{3\pi}{32} = 0.2945$$

Table XVIII

Average Collision Frequency for Weakly Ionized Gases Having $\nu = Av^n$

TABLE XVIII

AVERAGE COLLISION FREQUENCY FOR WEAKLY IONIZED PLASMA

$(\omega \gg \nu)$

$$Q_{e,n}^{(i)} = q_\ell^{(i)} E_{ev}^{\ell} = q_n^{(i)} v^{n-1} \quad ; \quad \bar{\nu}_{e,n}^{(i)} = N_i q_n^{(i)} v^n$$

$n = -3, \ \ell = -2$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100	1.4991E+30	1.2113E-01	5.3881E+27	5.5787E+10
200	5.3001E+29	4.2825E-02	9.5249E+26	1.9724E+10
250	3.7925E+29	3.0643E-02	5.4524E+26	1.4113E+10
300	2.8850E+29	2.3311E-02	3.4565E+26	1.0736E+10
350	2.2894E+29	1.8499E-02	2.3511E+26	8.5199E+09
400	1.8739E+29	1.5141E-02	1.6838E+26	6.9734E+09
450	1.5704E+29	1.2689E-02	1.2543E+26	5.8441E+09
500	1.3408E+29	1.0834E-02	9.6385E+25	4.9898E+09
600	1.0200E+29	8.2418E-03	6.1102E+25	3.7958E+09
700	8.0944E+28	6.5403E-03	4.1561E+25	3.0122E+09
800	6.6252E+28	5.3532E-03	2.9765E+25	2.4655E+09
900	5.5522E+28	4.4862E-03	2.2173E+25	2.0662E+09
1000	4.7406E+28	3.8304E-03	1.7039E+25	1.7641E+09
1500	2.5805E+28	2.0850E-03	6.1831E+24	9.6028E+08
2000	1.6761E+28	1.3543E-03	3.0120E+24	6.2372E+08
2500	1.1993E+28	9.6903E-04	1.7242E+24	4.4630E+08
3000	9.1233E+27	7.3717E-04	1.0930E+24	3.3951E+08
3500	7.2399E+27	5.8499E-04	7.4347E+23	2.6942E+08
4000	5.9257E+27	4.7880E-04	5.3246E+23	2.2052E+08
4500	4.9661E+27	4.0126E-04	3.9665E+23	1.8481E+08
5000	4.2401E+27	3.4260E-04	3.0489E+23	1.5779E+08
6000	3.2256E+27	2.6063E-04	1.9322E+23	1.2003E+08
7000	2.5597E+27	2.0682E-04	1.3143E+23	9.5255E+07
8000	2.0951E+27	1.6928E-04	9.4126E+22	7.7965E+07
9000	1.7558E+27	1.4187E-04	7.0118E+22	6.5339E+07
10000	1.4991E+27	1.2113E-04	5.3881E+22	5.5787E+07

$$\bar{\nu}_{e,n}^{(i)}(\mathrm{sec}^{-1}) = Y_\ell^{(i)} q_\ell^{(i)} \frac{\rho}{\rho_o} C_i = D_\ell^{(i)} q_\ell^{(i)} \cdot N_i(\mathrm{cm}^{-3}) = S_n^{(i)} q_n^{(i)} \frac{\rho}{\rho_o} C_i = R_\ell^{(i)} q_\ell^{(i)} P_{mmHg}^{(i)} = 3.721\mathrm{x}10^{-20} S_n^{(i)} q_n^{(i)} N_i$$

$$\bar{\nu}_{e,n} = \sum_i \bar{\nu}_{e,n}^{(i)}$$

Note: 1.4991E+30 means $1.4991\mathrm{x}10^{30}$
1.2113E-01 means $1.2113\mathrm{x}10^{-1}$, etc.

TABLE XVIII (Cont)

$n = -5/2, \ \ell = -7/4$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	4.1398E+29	2.5761E+02	1.4879E+27	1.5406E+10
200.	1.7406E+29	1.0831E+02	3.1280E+26	6.4773E+09
250.	1.3169E+29	8.1949E+01	1.8933E+26	4.9007E+09
300.	1.0485E+29	6.5248E+01	1.2562E+26	3.9020E+09
350.	8.6476E+28	5.3813E+01	8.8804E+25	3.2181E+09
400.	7.3183E+28	4.5540E+01	6.5758E+25	2.7234E+09
450.	6.3164E+28	3.9306E+01	5.0450E+25	2.3505E+09
500.	5.5369E+28	3.4455E+01	3.9802E+25	2.0605E+09
600.	4.4085E+28	2.7434E+01	2.6409E+25	1.6406E+09
700.	3.6359E+28	2.2625E+01	1.8669E+25	1.3530E+09
800.	3.0770E+28	1.9147E+01	1.3824E+25	1.1450E+09
900.	2.6557E+28	1.6526E+01	1.0606E+25	9.8828E+08
1000.	2.3280E+28	1.4487E+01	8.3673E+24	8.6633E+08
1500.	1.4024E+28	8.7268E+00	3.3603E+24	5.2188E+08
2000.	9.7880E+27	6.0909E+00	1.7590E+24	3.6425E+08
2500.	7.4056E+27	4.6084E+00	1.0647E+24	2.7559E+08
3000.	5.8963E+27	3.6692E+00	7.0642E+23	2.1942E+08
3500.	4.8629E+27	3.0261E+00	4.9938E+23	1.8097E+08
4000.	4.1154E+27	2.5609E+00	3.6979E+23	1.5315E+08
4500.	3.5520E+27	2.2103E+00	2.8370E+23	1.3218E+08
5000.	3.1137E+27	1.9376E+00	2.2382E+23	1.1587E+08
6000.	2.4791E+27	1.5427E+00	1.4851E+23	9.2256E+07
7000.	2.0446E+27	1.2723E+00	1.0498E+23	7.6087E+07
8000.	1.7303E+27	1.0767E+00	7.7738E+22	6.4391E+07
9000.	1.4934E+27	9.2932E-01	5.9640E+22	5.5575E+07
10000.	1.3091E+27	8.1465E-01	4.7053E+22	4.8717E+07

TABLE XVIII (Cont)

$n = -2, \ell = -3/2$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	1.2332E+29	5.9101E+05	4.4324E+26	4.5892E+09
200.	6.1660E+28	2.9551E+05	1.1081E+26	2.2946E+09
250.	4.9328E+28	2.3641E+05	7.0919E+25	1.8357E+09
300.	4.1107E+28	1.9700E+05	4.9249E+25	1.5297E+09
350.	3.5234E+28	1.6886E+05	3.6183E+25	1.3112E+09
400.	3.0830E+28	1.4775E+05	2.7703E+25	1.1473E+09
450.	2.7405E+28	1.3134E+05	2.1888E+25	1.0198E+09
500.	2.4664E+28	1.1820E+05	1.7730E+25	9.1784E+08
600.	2.0553E+28	9.8502E+04	1.2312E+25	7.6487E+08
700.	1.7617E+28	8.4430E+04	9.0457E+24	6.5560E+08
800.	1.5415E+28	7.3877E+04	6.9256E+24	5.7365E+08
900.	1.3702E+28	6.5668E+04	5.4721E+24	5.0991E+08
1000.	1.2332E+28	5.9101E+04	4.4324E+24	4.5892E+08
1500.	8.2214E+27	3.9401E+04	1.9700E+24	3.0595E+08
2000.	6.1660E+27	2.9551E+04	1.1081E+24	2.2946E+08
2500.	4.9328E+27	2.3641E+04	7.0919E+23	1.8357E+08
3000.	4.1107E+27	1.9700E+04	4.9249E+23	1.5297E+08
3500.	3.5234E+27	1.6886E+04	3.6183E+23	1.3112E+08
4000.	3.0830E+27	1.4775E+04	2.7703E+23	1.1473E+08
4500.	2.7405E+27	1.3134E+04	2.1888E+23	1.0198E+08
5000.	2.4664E+27	1.1820E+04	1.7730E+23	9.1784E+07
6000.	2.0553E+27	9.8502E+03	1.2312E+23	7.6487E+07
7000.	1.7617E+27	8.4430E+03	9.0457E+22	6.5560E+07
8000.	1.5415E+27	7.3877E+03	6.9256E+22	5.7365E+07
9000.	1.3702E+27	6.5668E+03	5.4721E+22	5.0991E+07
10000.	1.2332E+27	5.9101E+03	4.4324E+22	4.5892E+07

TABLE XVIII (Cont)

$n = -3/2, \ell = -5/4$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	3.8964E+28	1.4381E+09	1.4005E+26	1.4500E+09
200.	2.3168E+28	8.5512E+08	4.1636E+25	8.6217E+08
250.	1.9598E+28	7.2334E+08	2.8176E+25	7.2931E+08
300.	1.7093E+28	6.3090E+08	2.0479E+25	6.3610E+08
350.	1.5227E+28	5.6202E+08	1.5637E+25	5.6665E+08
400.	1.3776E+28	5.0846E+08	1.2378E+25	5.1265E+08
450.	1.2611E+28	4.6547E+08	1.0073E+25	4.6931E+08
500.	1.1653E+28	4.3010E+08	8.3767E+24	4.3365E+08
600.	1.0164E+28	3.7513E+08	6.0884E+24	3.7823E+08
700.	9.0540E+27	3.3418E+08	4.6489E+24	3.3693E+08
800.	8.1912E+27	3.0233E+08	3.6801E+24	3.0482E+08
900.	7.4987E+27	2.7677E+08	2.9946E+24	2.7905E+08
1000.	6.9289E+27	2.5574E+08	2.4904E+24	2.5785E+08
1500.	5.1121E+27	1.8868E+08	1.2249E+24	1.9024E+08
2000.	4.1200E+27	1.5206E+08	7.4040E+23	1.5332E+08
2500.	3.4851E+27	1.2863E+08	5.0104E+23	1.2969E+08
3000.	3.0397E+27	1.1219E+08	3.6417E+23	1.1312E+08
3500.	2.7078E+27	9.9942E+07	2.7807E+23	1.0077E+08
4000.	2.4497E+27	9.0418E+07	2.2012E+23	9.1164E+07
4500.	2.2426E+27	8.2773E+07	1.7912E+23	8.3456E+07
5000.	2.0722E+27	7.6484E+07	1.4896E+23	7.7115E+07
6000.	1.8074E+27	6.6709E+07	1.0827E+23	6.7259E+07
7000.	1.6101E+27	5.9426E+07	8.2670E+22	5.9916E+07
8000.	1.4566E+27	5.3763E+07	6.5443E+22	5.4206E+07
9000.	1.3335E+27	4.9217E+07	5.3253E+22	4.9623E+07
10000.	1.2322E+27	4.5478E+07	4.4286E+22	4.5853E+07

TABLE XVIII (Cont)

$n = -1, \ell = -1$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	1.2917E+28	3.6716E+12	4.6425E+25	4.8067E+08
200.	9.1334E+27	2.5962E+12	1.6414E+25	3.3989E+08
250.	8.1692E+27	2.3221E+12	1.1745E+25	3.0401E+08
300.	7.4574E+27	2.1198E+12	8.9345E+24	2.7752E+08
350.	6.9042E+27	1.9626E+12	7.0901E+24	2.5693E+08
400.	6.4583E+27	1.8358E+12	5.8031E+24	2.4034E+08
450.	6.0890E+27	1.7308E+12	4.8633E+24	2.2659E+08
500.	5.7765E+27	1.6420E+12	4.1524E+24	2.1496E+08
600.	5.2732E+27	1.4989E+12	3.1588E+24	1.9623E+08
700.	4.8820E+27	1.3877E+12	2.5067E+24	1.8168E+08
800.	4.5667E+27	1.2981E+12	2.0517E+24	1.6994E+08
900.	4.3055E+27	1.2239E+12	1.7195E+24	1.6022E+08
1000.	4.0846E+27	1.1611E+12	1.4681E+24	1.5200E+08
1500.	3.3351E+27	9.4801E+11	7.9913E+23	1.2411E+08
2000.	2.8883E+27	8.2100E+11	5.1905E+23	1.0748E+08
2500.	2.5833E+27	7.3432E+11	3.7140E+23	9.6135E+07
3000.	2.3582E+27	6.7034E+11	2.8253E+23	8.7759E+07
3500.	2.1833E+27	6.2062E+11	2.2421E+23	8.1249E+07
4000.	2.0423E+27	5.8053E+11	1.8351E+23	7.6001E+07
4500.	1.9255E+27	5.4733E+11	1.5379E+23	7.1655E+07
5000.	1.8267E+27	5.1924E+11	1.3131E+23	6.7978E+07
6000.	1.6675E+27	4.7400E+11	9.9891E+22	6.2055E+07
7000.	1.5438E+27	4.3884E+11	7.9270E+22	5.7452E+07
8000.	1.4441E+27	4.1050E+11	6.4881E+22	5.3741E+07
9000.	1.3615E+27	3.8702E+11	5.4374E+22	5.0668E+07
10000.	1.2917E+27	3.6716E+11	4.6425E+22	4.8067E+07

TABLE XVIII (Cont)

$n = -1/2, \ \ell = -3/4$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	4.4587E+27	9.7609E+15	1.6026E+25	1.6593E+08
200.	3.7493E+27	8.2079E+15	6.7379E+24	1.3953E+08
250.	3.5459E+27	7.7626E+15	5.0979E+24	1.3196E+08
300.	3.3879E+27	7.4167E+15	4.0589E+24	1.2608E+08
350.	3.2598E+27	7.1363E+15	3.3476E+24	1.2131E+08
400.	3.1528E+27	6.9020E+15	2.8330E+24	1.1733E+08
450.	3.0613E+27	6.7017E+15	2.4451E+24	1.1392E+08
500.	2.9817E+27	6.5275E+15	2.1434E+24	1.1096E+08
600.	2.8489E+27	6.2367E+15	1.7066E+24	1.0602E+08
700.	2.7412E+27	6.0009E+15	1.4075E+24	1.0201E+08
800.	2.6512E+27	5.8039E+15	1.1911E+24	9.8660E+07
900.	2.5742E+27	5.6355E+15	1.0280E+24	9.5797E+07
1000.	2.5073E+27	5.4890E+15	9.0118E+23	9.3307E+07
1500.	2.2656E+27	4.9598E+15	5.4287E+23	8.4312E+07
2000.	2.1084E+27	4.6157E+15	3.7890E+23	7.8461E+07
2500.	1.9940E+27	4.3652E+15	2.8667E+23	7.4204E+07
3000.	1.9052E+27	4.1707E+15	2.2825E+23	7.0898E+07
3500.	1.8331E+27	4.0130E+15	1.8825E+23	6.8217E+07
4000.	1.7729E+27	3.8813E+15	1.5931E+23	6.5978E+07
4500.	1.7215E+27	3.7687E+15	1.3750E+23	6.4063E+07
5000.	1.6767E+27	3.6707E+15	1.2053E+23	6.2398E+07
6000.	1.6020E+27	3.5071E+15	9.5968E+22	5.9618E+07
7000.	1.5415E+27	3.3746E+15	7.9148E+22	5.7364E+07
8000.	1.4909E+27	3.2638E+15	6.6981E+22	5.5480E+07
9000.	1.4476E+27	3.1691E+15	5.7811E+22	5.3871E+07
10000.	1.4100E+27	3.0867E+15	5.0677E+22	5.2470E+07

TABLE XVIII (Cont)

$n = 3, \ell = 1$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	5.7536E+24	2.0241E+40	2.0679E+22	2.1411E+05
200.	1.6273E+25	5.7250E+40	2.9245E+22	6.0560E+05
250.	2.2743E+25	8.0009E+40	3.2697E+22	8.4635E+05
300.	2.9896E+25	1.0517E+41	3.5818E+22	1.1125E+06
350.	3.7674E+25	1.3254E+41	3.8688E+22	1.4020E+06
400.	4.6028E+25	1.6193E+41	4.1359E+22	1.7129E+06
450.	5.4923E+25	1.9322E+41	4.3868E+22	2.0439E+06
500.	6.4327E+25	2.2630E+41	4.6241E+22	2.3938E+06
600.	8.4560E+25	2.9748E+41	5.0654E+22	3.1468E+06
700.	1.0656E+26	3.7487E+41	5.4713E+22	3.9654E+06
800.	1.3019E+26	4.5800E+41	5.8490E+22	4.8448E+06
900.	1.5535E+26	5.4650E+41	6.2038E+22	5.7810E+06
1000.	1.8194E+26	6.4007E+41	6.5394E+22	6.7708E+06
1500.	3.3425E+26	1.1759E+42	8.0091E+22	1.2439E+07
2000.	5.1461E+26	1.8104E+42	9.2481E+22	1.9151E+07
2500.	7.1919E+26	2.5301E+42	1.0340E+23	2.6764E+07
3000.	9.4540E+26	3.3259E+42	1.1327E+23	3.5182E+07
3500.	1.1913E+27	4.1911E+42	1.2234E+23	4.4334E+07
4000.	1.4555E+27	5.1206E+42	1.3079E+23	5.4166E+07
4500.	1.7368E+27	6.1101E+42	1.3872E+23	6.4633E+07
5000.	2.0342E+27	7.1562E+42	1.4623E+23	7.5699E+07
6000.	2.6740E+27	9.4071E+42	1.6018E+23	9.9509E+07
7000.	3.3696E+27	1.1854E+43	1.7302E+23	1.2540E+08
8000.	4.1169E+27	1.4483E+43	1.8496E+23	1.5320E+08
9000.	4.9125E+27	1.7282E+43	1.9618E+23	1.8281E+08
10000.	5.7536E+27	2.0241E+43	2.0679E+23	2.1411E+08

TABLE XVIII (Cont)

$n = 5/2, \ \ell = 3/4$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	1.3921E+25	6.3590E+36	5.0035E+22	5.1805E+05
200.	3.3110E+25	1.5124E+37	5.9502E+22	1.2321E+06
250.	4.3762E+25	1.9990E+37	6.2916E+22	1.6285E+06
300.	5.4963E+25	2.5107E+37	6.5850E+22	2.0454E+06
350.	6.6643E+25	3.0442E+37	6.8437E+22	2.4800E+06
400.	7.8749E+25	3.5972E+37	7.0760E+22	2.9305E+06
450.	9.1240E+25	4.1678E+37	7.2875E+22	3.3954E+06
500.	1.0408E+26	4.7545E+37	7.4820E+22	3.8733E+06
600.	1.3073E+26	5.9714E+37	7.8309E+22	4.8648E+06
700.	1.5851E+26	7.2404E+37	8.1386E+22	5.8985E+06
800.	1.8730E+26	8.5557E+37	8.4149E+22	6.9700E+06
900.	2.1701E+26	9.9127E+37	8.6663E+22	8.0756E+06
1000.	2.4755E+26	1.1308E+38	8.8976E+22	9.2124E+06
1500.	4.1095E+26	1.8772E+38	9.8469E+22	1.5293E+07
2000.	5.8879E+26	2.6895E+38	1.0581E+23	2.1911E+07
2500.	7.7821E+26	3.5548E+38	1.1188E+23	2.8960E+07
3000.	9.7740E+26	4.4647E+38	1.1710E+23	3.6373E+07
3500.	1.1851E+27	5.4135E+38	1.2170E+23	4.4102E+07
4000.	1.4004E+27	6.3968E+38	1.2583E+23	5.2113E+07
4500.	1.6225E+27	7.4115E+38	1.2959E+23	6.0379E+07
5000.	1.8509E+27	8.4548E+38	1.3305E+23	6.8879E+07
6000.	2.3247E+27	1.0619E+39	1.3926E+23	8.6509E+07
7000.	2.8187E+27	1.2875E+39	1.4473E+23	1.0489E+08
8000.	3.3307E+27	1.5214E+39	1.4964E+23	1.2395E+08
9000.	3.8590E+27	1.7628E+39	1.5411E+23	1.4361E+08
10000.	4.4022E+27	2.0109E+39	1.5822E+23	1.6382E+08

TABLE XVIII (Cont)

$n = 2,\ \ell = 1/2$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	3.4332E+25	2.0363E+33	1.2340E+23	1.2776E+06
200.	6.8664E+25	4.0727E+33	1.2340E+23	2.5553E+06
250.	8.5831E+25	5.0908E+33	1.2340E+23	3.1941E+06
300.	1.0300E+26	6.1090E+33	1.2340E+23	3.8329E+06
350.	1.2016E+26	7.1272E+33	1.2340E+23	4.4717E+06
400.	1.3733E+26	8.1453E+33	1.2340E+23	5.1105E+06
450.	1.5450E+26	9.1635E+33	1.2340E+23	5.7493E+06
500.	1.7166E+26	1.0182E+34	1.2340E+23	6.3881E+06
600.	2.0599E+26	1.2218E+34	1.2340E+23	7.6658E+06
700.	2.4033E+26	1.4254E+34	1.2340E+23	8.9434E+06
800.	2.7466E+26	1.6291E+34	1.2340E+23	1.0221E+07
900.	3.0899E+26	1.8327E+34	1.2340E+23	1.1499E+07
1000.	3.4332E+26	2.0363E+34	1.2340E+23	1.2776E+07
1500.	5.1498E+26	3.0545E+34	1.2340E+23	1.9164E+07
2000.	6.8664E+26	4.0727E+34	1.2340E+23	2.5553E+07
2500.	8.5831E+26	5.0908E+34	1.2340E+23	3.1941E+07
3000.	1.0300E+27	6.1090E+34	1.2340E+23	3.8329E+07
3500.	1.2016E+27	7.1272E+34	1.2340E+23	4.4717E+07
4000.	1.3733E+27	8.1453E+34	1.2340E+23	5.1105E+07
4500.	1.5450E+27	9.1635E+34	1.2340E+23	5.7493E+07
5000.	1.7166E+27	1.0182E+35	1.2340E+23	6.3881E+07
6000.	2.0599E+27	1.2218E+35	1.2340E+23	7.6658E+07
7000.	2.4033E+27	1.4254E+35	1.2340E+23	8.9434E+07
8000.	2.7466E+27	1.6291E+35	1.2340E+23	1.0221E+08
9000.	3.0899E+27	1.8327E+35	1.2340E+23	1.1499E+08
10000.	3.4332E+27	2.0363E+35	1.2340E+23	1.2776E+08

TABLE XVIII (Cont)

$n = 3/2, \ell = 1/4$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	8.6439E+25	6.6571E+29	3.1068E+23	3.2167E+06
200.	1.4537E+26	1.1196E+30	2.6125E+23	5.4098E+06
250.	1.7186E+26	1.3235E+30	2.4708E+23	6.3954E+06
300.	1.9704E+26	1.5175E+30	2.3607E+23	7.3325E+06
350.	2.2119E+26	1.7035E+30	2.2714E+23	8.2312E+06
400.	2.4449E+26	1.8829E+30	2.1968E+23	9.0982E+06
450.	2.6707E+26	2.0568E+30	2.1331E+23	9.9385E+06
500.	2.8903E+26	2.2259E+30	2.0776E+23	1.0756E+07
600.	3.3138E+26	2.5521E+30	1.9851E+23	1.2332E+07
700.	3.7199E+26	2.8649E+30	1.9100E+23	1.3843E+07
800.	4.1118E+26	3.1667E+30	1.8473E+23	1.5301E+07
900.	4.4915E+26	3.4591E+30	1.7937E+23	1.6715E+07
1000.	4.8608E+26	3.7435E+30	1.7471E+23	1.8089E+07
1500.	6.5884E+26	5.0740E+30	1.5787E+23	2.4518E+07
2000.	8.1749E+26	6.2959E+30	1.4691E+23	3.0422E+07
2500.	9.6642E+26	7.4428E+30	1.3894E+23	3.5964E+07
3000.	1.1080E+27	8.5334E+30	1.3275E+23	4.1234E+07
3500.	1.2438E+27	9.5793E+30	1.2773E+23	4.6287E+07
4000.	1.3749E+27	1.0588E+31	1.2354E+23	5.1163E+07
4500.	1.5018E+27	1.1566E+31	1.1995E+23	5.5888E+07
5000.	1.6253E+27	1.2517E+31	1.1683E+23	6.0484E+07
6000.	1.8635E+27	1.4351E+31	1.1163E+23	6.9347E+07
7000.	2.0919E+27	1.6110E+31	1.0741E+23	7.7846E+07
8000.	2.3122E+27	1.7807E+31	1.0388E+23	8.6046E+07
9000.	2.5258E+27	1.9452E+31	1.0087E+23	9.3993E+07
10000.	2.7334E+27	2.1052E+31	9.8246E+22	1.0172E+08

TABLE XVIII (Cont)

$n = 1,\ \ell = 0$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	2.2259E+26	2.2259E+26	8.0002E+23	8.2832E+06
200.	3.1478E+26	3.1478E+26	5.6570E+23	1.1714E+07
250.	3.5194E+26	3.5194E+26	5.0598E+23	1.3097E+07
300.	3.8553E+26	3.8553E+26	4.6189E+23	1.4347E+07
350.	4.1642E+26	4.1642E+26	4.2763E+23	1.5496E+07
400.	4.4517E+26	4.4517E+26	4.0001E+23	1.6566E+07
450.	4.7218E+26	4.7218E+26	3.7713E+23	1.7571E+07
500.	4.9772E+26	4.9772E+26	3.5778E+23	1.8522E+07
600.	5.4522E+26	5.4522E+26	3.2661E+23	2.0290E+07
700.	5.8891E+26	5.8891E+26	3.0238E+23	2.1915E+07
800.	6.2957E+26	6.2957E+26	2.8285E+23	2.3428E+07
900.	6.6776E+26	6.6776E+26	2.6667E+23	2.4850E+07
1000.	7.0388E+26	7.0388E+26	2.5299E+23	2.6194E+07
1500.	8.6207E+26	8.6207E+26	2.0656E+23	3.2081E+07
2000.	9.9543E+26	9.9543E+26	1.7889E+23	3.7044E+07
2500.	1.1129E+27	1.1129E+27	1.6000E+23	4.1416E+07
3000.	1.2192E+27	1.2192E+27	1.4606E+23	4.5369E+07
3500.	1.3168E+27	1.3168E+27	1.3523E+23	4.9004E+07
4000.	1.4078E+27	1.4078E+27	1.2649E+23	5.2388E+07
4500.	1.4932E+27	1.4932E+27	1.1926E+23	5.5565E+07
5000.	1.5739E+27	1.5739E+27	1.1314E+23	5.8571E+07
6000.	1.7241E+27	1.7241E+27	1.0328E+23	6.4162E+07
7000.	1.8623E+27	1.8623E+27	9.5621E+22	6.9302E+07
8000.	1.9909E+27	1.9909E+27	8.9445E+22	7.4087E+07
9000.	2.1116E+27	2.1116E+27	8.4330E+22	7.8581E+07
10000.	2.2259E+27	2.2259E+27	8.0002E+22	8.2832E+07

TABLE XVIII (Cont)

$n = 0,\ \ell = -1/2$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	1.5938E+27	2.6872E+19	5.7286E+24	5.9313E+07
200.	1.5938E+27	2.6872E+19	2.8643E+24	5.9313E+07
250.	1.5938E+27	2.6872E+19	2.2914E+24	5.9313E+07
300.	1.5938E+27	2.6872E+19	1.9095E+24	5.9313E+07
350.	1.5938E+27	2.6872E+19	1.6367E+24	5.9313E+07
400.	1.5938E+27	2.6872E+19	1.4321E+24	5.9313E+07
450.	1.5938E+27	2.6872E+19	1.2730E+24	5.9313E+07
500.	1.5938E+27	2.6872E+19	1.1457E+24	5.9313E+07
600.	1.5938E+27	2.6872E+19	9.5477E+23	5.9313E+07
700.	1.5938E+27	2.6872E+19	8.1837E+23	5.9313E+07
800.	1.5938E+27	2.6872E+19	7.1607E+23	5.9313E+07
900.	1.5938E+27	2.6872E+19	6.3651E+23	5.9313E+07
1000.	1.5938E+27	2.6872E+19	5.7286E+23	5.9313E+07
1500.	1.5938E+27	2.6872E+19	3.8191E+23	5.9313E+07
2000.	1.5938E+27	2.6872E+19	2.8643E+23	5.9313E+07
2500.	1.5938E+27	2.6872E+19	2.2914E+23	5.9313E+07
3000.	1.5938E+27	2.6872E+19	1.9095E+23	5.9313E+07
3500.	1.5938E+27	2.6872E+19	1.6367E+23	5.9313E+07
4000.	1.5938E+27	2.6872E+19	1.4321E+23	5.9313E+07
4500.	1.5938E+27	2.6872E+19	1.2730E+23	5.9313E+07
5000.	1.5938E+27	2.6872E+19	1.1457E+23	5.9313E+07
6000.	1.5938E+27	2.6872E+19	9.5477E+22	5.9313E+07
7000.	1.5938E+27	2.6872E+19	8.1837E+22	5.9313E+07
8000.	1.5938E+27	2.6872E+19	7.1607E+22	5.9313E+07
9000.	1.5938E+27	2.6872E+19	6.3651E+22	5.9313E+07
10000.	1.5938E+27	2.6872E+19	5.7286E+22	5.9313E+07

TABLE XVIII (Cont)

$n = 1/2, \ell = -1/4$

T, °K	Y_ℓ	S_n	R_ℓ	D_ℓ
100.	5.8752E+26	7.6287E+22	2.1117E+24	2.1864E+07
200.	6.9868E+26	9.0720E+22	1.2556E+24	2.6000E+07
250.	7.3876E+26	9.5925E+22	1.0621E+24	2.7492E+07
300.	7.7322E+26	1.0040E+23	9.2637E+23	2.8774E+07
350.	8.0360E+26	1.0434E+23	8.2523E+23	2.9905E+07
400.	8.3088E+26	1.0789E+23	7.4659E+23	3.0920E+07
450.	8.5570E+26	1.1111E+23	6.8346E+23	3.1844E+07
500.	8.7854E+26	1.1407E+23	6.3153E+23	3.2694E+07
600.	9.1951E+26	1.1939E+23	5.5082E+23	3.4218E+07
700.	9.5564E+26	1.2409E+23	4.9068E+23	3.5563E+07
800.	9.8808E+26	1.2830E+23	4.4392E+23	3.6770E+07
900.	1.0176E+27	1.3213E+23	4.0639E+23	3.7869E+07
1000.	1.0448E+27	1.3566E+23	3.7551E+23	3.8880E+07
1500.	1.1562E+27	1.5013E+23	2.7705E+23	4.3027E+07
2000.	1.2424E+27	1.6133E+23	2.2328E+23	4.6236E+07
2500.	1.3137E+27	1.7058E+23	1.8887E+23	4.8889E+07
3000.	1.3750E+27	1.7854E+23	1.6473E+23	5.1169E+07
3500.	1.4290E+27	1.8555E+23	1.4675E+23	5.3179E+07
4000.	1.4775E+27	1.9185E+23	1.3276E+23	5.4984E+07
4500.	1.5217E+27	1.9758E+23	1.2154E+23	5.6627E+07
5000.	1.5623E+27	2.0286E+23	1.1230E+23	5.8139E+07
6000.	1.6352E+27	2.1232E+23	9.7951E+22	6.0850E+07
7000.	1.6994E+27	2.2066E+23	8.7257E+22	6.3241E+07
8000.	1.7571E+27	2.2815E+23	7.8942E+22	6.5388E+07
9000.	1.8096E+27	2.3497E+23	7.2267E+22	6.7342E+07
10000.	1.8579E+27	2.4124E+23	6.6777E+22	6.9139E+07

Appendix

APPENDIX

The today outdated Model II is here included as an illustration of changes resulting in the drastic alteration of electron cross section for O_2 at energies below 0.25 ev.

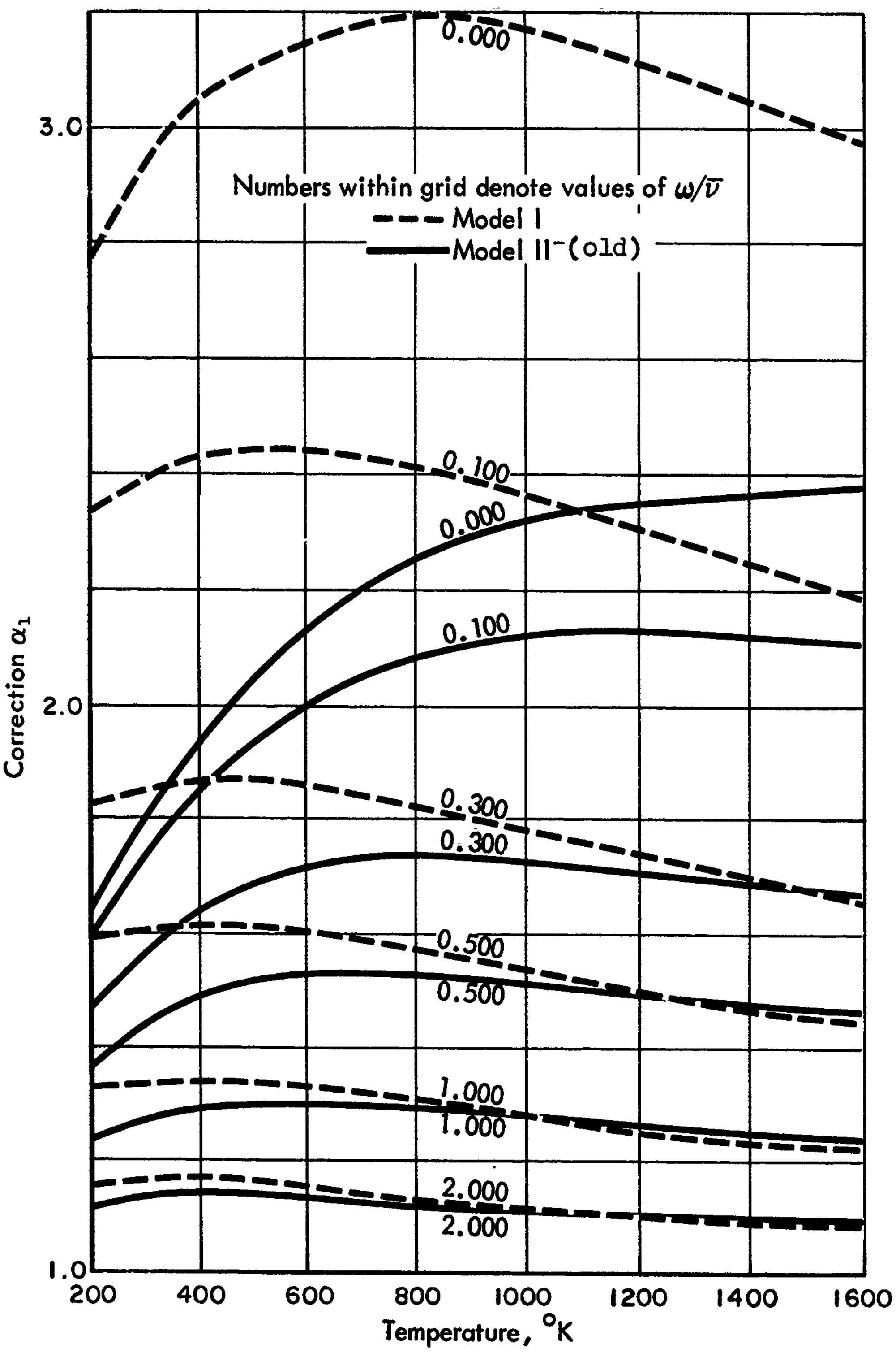


FIGURE 27 Comparison of Correction α_1 from Models I and II (Air)

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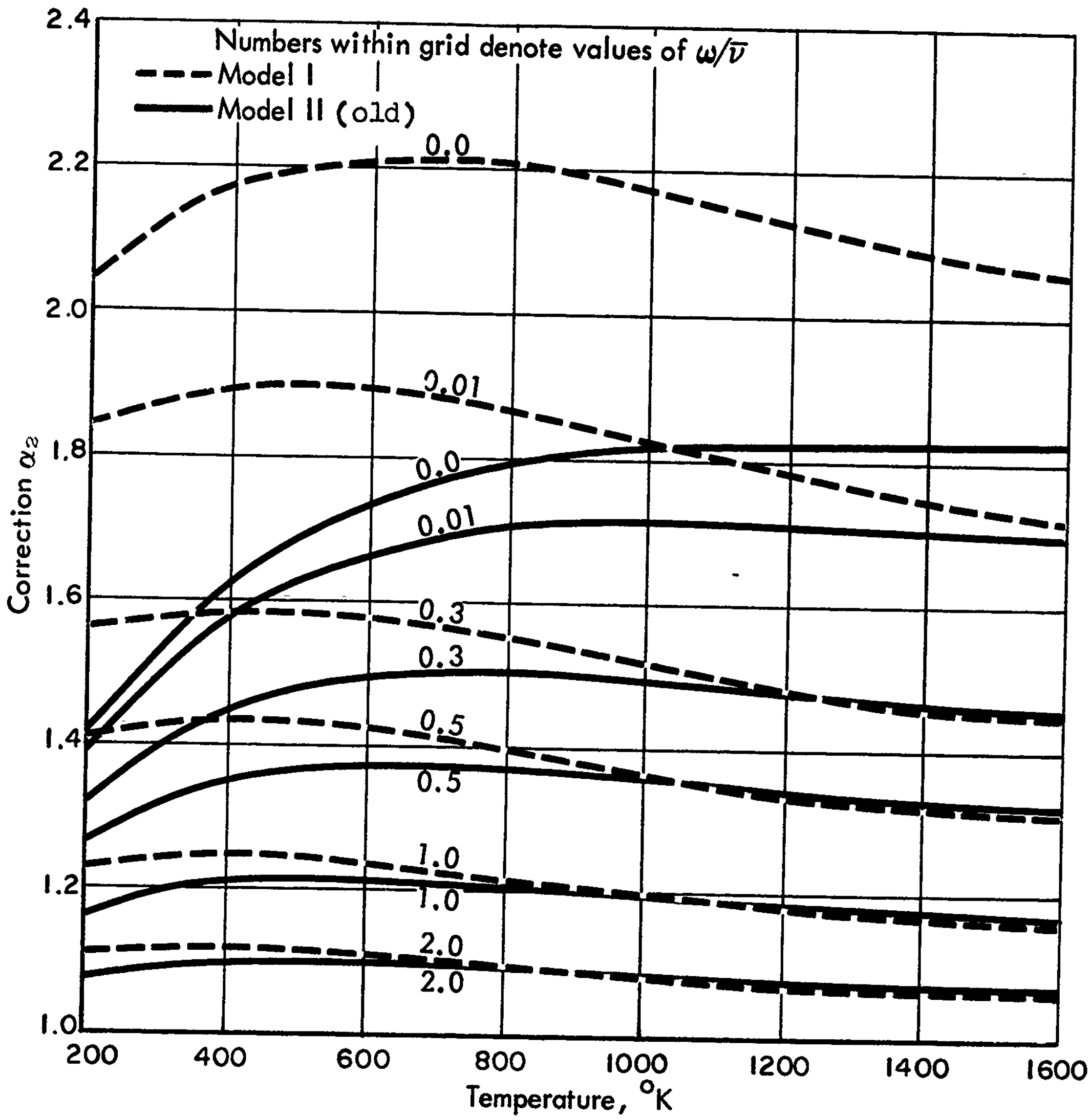

FIGURE 28 Comparison of Correction α_2 from Model I and II (Air)